

# **Department of Veterans Affairs Minneapolis, MN Medical Center**

## **Renovate to Create Hybrid OR, Phase 2 100% CD Issue**

**VA IDIQ A/E Services Contract VA263-P-1212**

**VA Project No. 618-CSI-100**

**BWBR Commission No. 3.2012151.00**

Prepared by:

BWBR  
380 St. Peter Street, Suite 600  
St. Paul, MN 55102  
651-222-3701

Dunham  
50 South Sixth Street, Suite 1100  
Minneapolis, MN 55402  
612-465-7550

VAA  
2300 Berkshire Lane North, Suite 200  
Plymouth, MN 55441  
763-559-9100

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**SECTION 01 00 00  
GENERAL REQUIREMENTS**

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**SECTION 01 00 00  
GENERAL REQUIREMENTS**

**1.1 GENERAL INTENTION**

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work as required by drawings and specifications.
- B. Visits to the site by Bidders may be made only by appointment with the Contracting Officer.
- C. Offices of BWBR as Architects and Dunham and Associates as Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.
- D. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.
- E. Prior to commencing work, general contractor shall provide proof that a 30 Hour OSHA certified "competent person" will maintain a presence at the work site whenever the general or subcontractors are present. The General Contractor shall have, at all times, a Job Superintendent to manage the construction activities for the project. The Job Superintendent for the General Contractor for this project shall not manage other projects within Minneapolis VA Health Care System or outside of the Minneapolis VA Health Care System. The Job Superintendent for this project shall be dedicated to only this project. The job superintendent shall attend all project construction meetings unless the COR approves the absence ahead of time. In the event that the dedicated Job Superintendent cannot be at the project construction site, the General Contractor shall provide a replacement Job Superintendent. The General Contractor shall submit to the COR a resume' for the replacement Job Superintendent and have prior approval from the COR that the replacement Job Superintendent is acceptable and has the experience to manage this project.
- F. Training:
  - 1. All employees of general contractor or subcontractors shall have the 10-hour OSHA certified Construction Safety course and /or other relevant competency training, as determined by VA CP with input from the ICRA team.
  - 2. Submit training records of all such employees for approval before the start of work.
- G. Confined Space Training:
  - 1. The VA Medical Center Property has been surveyed for Permit Required Confined Spaces. An inventory of the spaces including the hazards and entry procedures are available from the Safety

Manager. Entry may be required for the installation of electrical systems, controls, plumbing, pipe fitting and insulation as part of the project scope.

2. Contractor shall be trained in confined space entry prior to entering confined space. Submit training records of all such employees for approval before start of work.

## **1.2 STATEMENT OF BID ITEM(S)**

Bid Option No. 1 – Hybrid OR Wainscoting.

Solid surface wall protection within Hybrid OR 20 and Hybrid OR 21. See Finish Schedule on AI601.2 for additional information.

Bid Option No. 2 – Clad Wood Doors

Solid core wood doors with protective cladding at all doors within suite. See Finish Schedule on AI601.2 for additional information

Bid Option No. 3 – Casework Material Options.

All manufactured metal casework made of stainless steel. See interior elevations on AI401.2 for additional information.

Bid Option No. 4 – CO2 Manifold in Secured Enclosure System.

CO2 Manifold and chain-link fence enclosure. See sheets AI501.2 and MG02.2 for additional information.

Bid Option No. 5 – Stainless Steel Air Curtain Finish

All surgical laminar flow and curtain wall, supply diffusers to be stainless steel construction with #4 brushed finish. See sheet M05.2 for additional information.

## **1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR**

- A. AFTER AWARD OF CONTRACT, Specifications and drawings will be furnished electronically on a compact disk. Drawing and specification will be in Adobe PDF format.
- B. Hard Copy drawings and specifications may be made by the Contractor, at the Contractor's expense, from electronic files furnished by the Issuing Contracting Officer. No hard copy drawings or specifications will be furnished to the contractor or subcontractors.

## **1.4 CONSTRUCTION SECURITY REQUIREMENTS**

A. Security Plan:

1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.

B. Security Procedures:

1. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
  2. For working outside the "regular hours" as defined in the contract, the General Contractor shall give 3 days' notice to the Project Manager so that security/escort arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
  3. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access. Each contractor or subcontractor employee shall obtain a security clearance from the VA Medical Center. Obtaining a security clearance will require each contractor and/or subcontractor employee to report to the Facilities Engineering Project Section to complete paperwork and visit Human Resource Management for finger printing. When the employee has been cleared to work at the Medical Center, the employee shall return to have a picture taken and will be issued a badge at that time. Employees must schedule appointments with a Facilities Engineering Project Manager prior to arriving on site to complete security clearance paperwork. This process could take up to thirty days.
  4. No photography of VA premises is allowed without written permission of the Contracting Officer.
  5. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.
- C. Guards: Not used
- D. Key Control:
1. The General Contractor shall provide duplicate keys and lock combinations to the Project Manager for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
  2. The General Contractor shall turn over all permanent lock cylinders to the VA locksmith for permanent installation. See Section 08 71 00 Door Hardware and coordinate.
- E. Document Control:
1. Before starting any work, the General Contractor/Subcontractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".
  2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.

3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
  4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
  5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
  6. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
  7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
    - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
    - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.
- F. Motor Vehicle Restrictions
1. The Contractor is directed to consider that there will be additional concurrent construction projects at the VAMC that could affect workflow and/or scheduling.
  2. Contractor's vehicles and worker's vehicles are to be parked in Employee Parking lots. Coordinate with Project Manager.
  3. Shipping/Receiving dock parking; access shall be restricted to picking up and dropping off materials and supplies. No parking will be allowed at the dock.

## **1.5 FIRE SAFETY**

- A. Applicable Publications: Publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only. The most recent versions of each publication apply.
1. American Society for Testing and Materials (ASTM):  
E84 .....Surface Burning Characteristics of Building Materials
  2. National Fire Protection Association (NFPA):  
10 .....Standard for Portable Fire Extinguishers  
30 .....Flammable and Combustible Liquids Code  
51B.....Standard for Fire Prevention During Welding, Cutting and Other Hot  
Work  
70 .....National Electrical Code



101.....Life Safety Code

241.....Standard for Safeguarding Construction, Alteration, and Demolition  
Operations

3. Occupational Safety and Health Administration (OSHA):

29 CFR 1926.....Safety and Health Regulations for Construction

- B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to the Project Manager for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the general contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, etc. Documentation shall be provided to the Project Manager that individuals have undergone contractor's safety briefing.
- C. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- E. Temporary Construction Partitions:
1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas and adjoining areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire retardant treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck, interstitial deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
  2. Install fire-rated temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
  3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.
- F. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.

- G. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with the Project Manager.
- H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to the Project Manager.
- I. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- J. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- K. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers. During construction turn existing sprinkler piping up and replace with sprinklers heads with heads designed to be installed in the upright position.
- L. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with paragraph 1.6, OPERATIONS AND STORAGE AREAS, and coordinate with Project Manager. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the Project Manager.
- M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Project Manager.
- N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Project Manager. Obtain permits from Project Manager the morning the work is to be completed, provide a minimum of 24 hr. notice. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Project Manager.
- P. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- Q. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- R. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.
- S. If required, submit documentation to the Project Manager that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

## **1.6 OPERATIONS AND STORAGE AREAS**

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.
- C. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.
- D. Working space and space available for storing materials shall be as determined by the Project Manager. Storage space is limited. The Contractor should consider other means of storage other than using mechanical rooms or VA Medical Center spaces.
- E. Workmen are subject to rules of Medical Center applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by Project Manager where required by limited working space.
  - 1. Do not store materials and equipment in other than assigned areas. All storage locations must be approved by project COR.
  - 2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.
  - 3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

4. All materials stored on VA Premises must be labeled with contractor name, point of contact, telephone number, project title, date of storage, and project CO.
- G. Access to the project construction site shall be through the main corridors. Delivery of materials shall be accomplished using the freight elevator. Passenger elevator shall not be used to deliver materials. At no time shall the Contractor or Contractor's Subs, enter the operating room suite without proper authorization or the required protective clothing that shall include booties, hair bonnet and bunny suite. These items will be provided to the Contractor at no cost.
- H. Phasing: N/A
- I. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Project Manager.
  - a. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of Project Manager. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without an Energized Circuit Permit issued by the Project Manager. Refer to specification Section 26 05 11 for additional requirements.
  - b. Contractor shall submit a request to interrupt any such services to Project Manager, in writing, 25 days in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
  - c. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours.
  - d. Major interruptions of any system must be requested, in writing, at least 25 calendar days prior to the desired time and shall be performed as directed by the Project Manager.
  - e. In the event of a shutdown that will affect scheduled surgeries the interruption shall be scheduled after 8:00 p.m. Monday through Friday. All utilities must be operational before 5:00 a.m. in the morning. If an interruption of a utility cannot be restored by 5:00 a.m. in the morning the interruption shall be scheduled between the hours of Saturday 12 noon and Monday morning at 5:00 a.m. Testing and certification shall be completed by the required 5:00 a.m. deadline.

- f. In case of a contract construction emergency, service will be interrupted on approval of Project Manager. Such approval will be confirmed in writing as soon as practical.
  - g. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor. N/A
- J. Abandoned Lines: All unused service lines shall be demoed to the source unless approved by the COR. All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces. Water supply piping and waste piping shall be removed back to mains in the interstitial space. Mains shall be drained and the mains cut and the Ts or Ys removed and the mains repaired to maintain waste or water supply service to adjoining areas.
- K. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
  - h. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
  - i. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the Project Manager.
- L. Coordinate the work for this contract with other construction operations as directed by Project Manager. This includes the scheduling of traffic and the use of roadways, as specified in paragraph 1.16, USE OF ROADWAYS.
- M. Work Hours for noise producing activities: Noise producing activities shall be accomplished before 6:00 a.m. and after 5:00 p.m. and on Saturdays and Sundays.

## **1.7 ALTERATIONS**

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of areas of buildings in which alterations occur and areas which are anticipated routes of access, Project Manager, signed by both, to the Contracting Officer. This report shall list by rooms and spaces:
  - 1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of building.

2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
  3. Shall note any discrepancies between drawings and existing conditions at site.
  4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and Project Manager.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of Project Manager, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly.
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and Project Manager together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:
1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
  2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
  3. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

#### **1.8 INFECTION PREVENTION MEASURES**

- A. Implement the requirements of VAMC's Infection Control Risk Assessment (ICRA) team. ICRA Group may monitor dust in the vicinity of the construction work and require the Contractor to take corrective action immediately if the safe levels are exceeded.

- B. Establish and maintain a dust control program as part of the contractor's infection preventive measures in accordance with the guidelines provided by ICRA Group. Prior to start of work, prepare a plan detailing project-specific dust protection measures, including periodic status reports, and submit to Project Manager for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA SAMPLES.
1. All personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.
- C. Medical center Infection Control personnel shall monitor for airborne disease (e.g. aspergillosis) as appropriate during construction. A baseline of conditions may be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality. In addition:
1. The COR and VAMC Infection Control personnel shall review pressure differential monitoring documentation to verify that pressure differentials in the construction zone and in the patient-care rooms are appropriate for their settings. The requirement for negative air pressure in the construction zone shall depend on the location and type of activity. Upon notification, the contractor shall implement corrective measures to restore proper pressure differentials as needed.
  2. In case of any problem, the medical center, along with assistance from the contractor, shall conduct an environmental assessment to find and eliminate the source.
- D. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.
1. Dampen debris to keep down dust and provide temporary construction partitions in existing structures where directed by Project Manager. Blank off ducts and diffusers to prevent circulation of dust into occupied areas during construction.
  2. Do not perform dust producing tasks within occupied areas without the approval of the Project Manager. For construction in any areas that will remain jointly occupied by the medical Center and Contractor's workers, the Contractor shall:
    - a. Provide dust proof fire-rated temporary drywall construction barriers to completely separate construction from the operational areas of the hospital in order to contain dirt debris and dust. Barriers shall be sealed and made presentable on hospital occupied side. Install a self-closing rated door in a metal frame, commensurate with the partition, to allow worker access. Maintain negative air at all times. The General Contractor shall coordinate with the Mechanical Contractor and provide and install equipment to monitor negative air flow in the construction area. In the event there is more than one entrance to the construction site negative monitoring shall be installed at those locations. Monitoring should be visible at all times to

Contractor and VA personnel. A fire retardant polystyrene, 6-mil thick or greater plastic barrier meeting local fire codes may be used where dust control is the only hazard, and an agreement is reached with the Project Manager and Medical Center.

- b. HEPA filtration is required where the exhaust dust may reenter the breathing zone. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. Install HEPA (High Efficiency Particulate Accumulator) filter vacuum system rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. Insure continuous negative air pressures occurring within the work area. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Exhaust hoses shall be heavy duty, flexible steel reinforced and exhausted so that dust is not reintroduced to the medical center.
- c. Adhesive Walk-off/Carpet Walk-off Mats, minimum 600mm x 900mm (24" x 36"), shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.
- d. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as they are created. Transport these outside the construction area in containers with tightly fitting lids.
- e. The contractor shall not haul debris through patient-care areas without prior approval of the Project Manager and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.
- f. Delivery of materials: All materials being delivered to the project site or any Contractor storage areas shall be covered during transportation through the medical center.
- g. Using a HEPA vacuum, clean inside the barrier and vacuum ceiling tile prior to replacement. Any ceiling access panels opened for investigation beyond sealed areas shall be sealed immediately when unattended.
- h. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.



- i. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.
- E. Final Cleanup:
  - 1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
  - 2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
  - 3. All new air ducts shall be cleaned prior to final inspection.

## **1.9 DISPOSAL AND RETENTION**

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
  - 1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by Project Manager.
  - 2. Items not reserved shall become property of the Contractor and be removed by Contractor.
  - 3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.

### **1.10 PCB TRANSFORMERS AND CAPACITORS: NOT APPLICABLE**

### **1.11 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS**

- A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.
- B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the

Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

- C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to paragraphs 1.6 Operations and Storage Areas, 1.7 Alterations, 1.11 Restoration for additional instructions concerning repair of damage to structures and site improvements.

#### **1.12 RESTORATION**

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the Project Manager. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the Project Manager before it is disturbed. Materials and workmanship used in restoring work shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with the FAR.

#### **1.13 PHYSICAL DATA – NOT USED**

#### **1.14 PROFESSIONAL SURVEYING SERVICES – NOT USED**

#### **1.15 LAYOUT OF WORK – NOT USED**

#### **1.16 AS-BUILT DRAWINGS**

- A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the Project Manager's review, as often as requested.

- C. Contractor shall deliver two approved completed sets of as-built drawings to the COR within 15 calendar days after each completed phase and after the acceptance of the project by the COR. The As-builts will be reviewed by the COR. In the event of discrepancies the Contractor shall issue a new and clean set of as-built drawings. Provide two hardcopy and one CD with as-built drawings completed with AutoCADD 2015 and PDF.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

#### **1.17USE OF ROADWAYS**

- A. For hauling, use only established public roads and roads on Medical Center property and, when authorized by the Project Manager, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.
- B. When new permanent roads are to be a part of this contract, Contractor may construct them immediately for use to facilitate building operations. These roads may be used by all who have business thereon within zone of building operations.
- C. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at time set for completion of such buildings or parts thereof.

#### **1.18TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT**

- A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to compliance with the following provisions:
  - 1. Permission to use each unit or system must be given by Project Manager. If the equipment is not installed and maintained in accordance with the following provisions, the Project Manager will withdraw permission for use of the equipment.
  - 2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.
  - 3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
  - 4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.

5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
  6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.
- B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.
- C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

#### **1.19TEMPORARY USE OF EXISTING ELEVATORS**

- A. Use of existing elevators for handling building materials and Contractor's personnel will be permitted subject to following provisions:
1. Contractor makes all arrangements with the Project Manager for use of elevators. The Project Manager will ascertain that elevators are in proper condition. Contractor may use freight elevators.
  2. Contractor covers and provides maximum protection of following elevator components:
    - a. Entrance jambs, heads soffits and threshold plates.
    - b. Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
    - c. Finish flooring.
  3. Government will accept hoisting ropes of elevator and rope of each speed governor if they are worn under normal operation. However, if these ropes are damaged by action of foreign matter such as sand, lime, grit, stones, etc., during temporary use, they shall be removed and replaced by new hoisting ropes.

#### **1.20TEMPORARY USE OF NEW ELEVATORS – NOT USED**

#### **1.21TEMPORARY TOILETS**

- A. Contractor may have for use of Contractor's workmen, such toilet accommodations as may be assigned to Contractor by Medical Center. Contractor shall keep such places clean and be responsible for any damage done thereto by Contractor's workmen. Failure to maintain satisfactory condition in toilets will deprive Contractor of the privilege to use such toilets.

#### **1.22AVAILABILITY AND USE OF UTILITY SERVICES**

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.

- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- C. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:
  - 1. Obtain heat by connecting to Medical Center heating distribution system.
    - a. Steam is available at no cost to Contractor.
- D. Electricity (for Construction and Testing): Furnish all temporary electric services.
  - 1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.
- E. Water (for Construction and Testing): Furnish temporary water service.
  - 1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection. Water is available at no cost to the Contractor.
  - 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at Project Manager's discretion) of use of water from Medical Center's system.
- F. Steam: Furnish steam system for testing required in various sections of specifications.
  - 1. Obtain steam for testing by connecting to the Medical Center steam distribution system. Steam is available at no cost to the Contractor.
  - 2. Maintain connections, pipe, fittings and fixtures and conserve steam-use so none is wasted. Failure to stop leakage or other waste will be cause for revocation (at Project Manager's discretion), of use of steam from the Medical Center's system.
- G. Fuel: Natural and LP gas and burner fuel oil required for boiler cleaning, normal initial boiler-burner setup and adjusting, and for performing the specified boiler tests will be furnished by the Government. Fuel required for prolonged boiler-burner setup, adjustments, or modifications due to improper design or operation of boiler, burner, or control devices shall be furnished by the Contractor at Contractor's expense.

### **1.23NEW TELEPHONE EQUIPMENT**

The contractor shall coordinate with the work of installation of telephone equipment by others. This work shall be completed before the building is turned over to VA.

### **1.24TESTS**

- A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.
- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a complex which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feed water, condensate and other related components.
- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

### **1.25INSTRUCTIONS**

- A. Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the Project Manager coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation

of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

- C. Contractor shall provide Lockout/Tag-out Procedures for all new equipment supplied with this project. Use the form "Lockout/Tag-out Procedures for \_\_\_\_\_" as a template for procedures. Provide photos as required to identify the location of the isolation device. For any new equipment furnished which requires non-standard Lockout devices, contractor to provide three (3) such devices to the Medical Center.
- D. Contractor shall provide Confined Space Entry Procedures for all new equipment which contains confined spaces as assessed by a qualified individual. Use "MVAHCS Confined Space Assessment Form" to evaluate each piece of equipment, and identify hazards.
- E. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the Project Manager and shall be considered concluded only when the Project Manager is satisfied in regard to complete and thorough coverage. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the Project Manager, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.
- F. Final O&M Manuals shall be provided at the close out of the project. O&M Manuals shall be indexed to reflect specifications sections for materials and equipment covered in the specifications. Include all equipment and materials submitted and/or provided for the project. Include samples of approved finishes. Include one set of As-built drawings. Provide one complete hardcopy O&M Manual and One CD of O&M Manual.

#### **1.26 GOVERNMENT-FURNISHED PROPERTY**

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on the drawings.
- B. Equipment furnished by Government to be installed by Contractor will be furnished to Contractor at the Medical Center.
- C. Contractor shall be prepared to receive this equipment from Government and store or place such equipment not less than 30 days before Completion Date of project.

- D. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.
  - 1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
  - 2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.
- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

#### **1.27RELOCATED EQUIPMENT**

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated on drawings or otherwise shown to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the Project Manager.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- E. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.



**1.28 STORAGE SPACE FOR DEPARTMENT OF VETERANS AFFAIRS EQUIPMENT – NOT USED**

**1.29 CONSTRUCTION SIGN – NOT USED**

**1.30 SAFETY SIGN – NOT USED**

**1.31 CONSTRUCTION DIGITAL IMAGES – NOT USED**

**1.32 FINAL ELEVATION DIGITAL IMAGES – NOT USED**

**1.33 HISTORIC PRESERVATION**

Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the Project Manager verbally, and then with a written follow up.

**1.34 COMPLETION TIME**

Contractor shall complete all related project construction and testing within time limit specified in SOW.

**1.35 SCHEDULES**

The Contractor shall prepare a **bar-type construction schedule** (Gantt Chart) for the project within five business days after the Notice to Proceed. The schedule must provide sufficient detail to manage the work and determine progress for each building on the VAMC campus and for distinct work sites within an individual building, especially Building 70. It shall be the Contractor's responsibility to notify the Contracting officer immediately if there is any reason why the schedule cannot be met. Failure to do so can result in default action. The Contractor shall submit updated schedules to reflect current conditions on a monthly basis. Submit with payment application.

**1.36 LIQUIDATED DAMAGES**

The Contractor will be assessed liquidated damages in the amount of **\$200.00** per day for every day after the scheduled completion date of the Project. Saturday's, Sunday's and holidays will be included when assessing liquidated damages.

**1.37 CONTRACTOR'S COST BREAKDOWN (SCHEDULE OF VALUES)**

Within 10 calendar days of receipt of the Notice to Proceed, the Contractor shall submit to the Project Manager a Contractor's cost breakdown. The cost breakdown shall include all values for all tasks required to complete the project.

**1.38 SUBCONTRACTORS**

Within 10 calendar days of receipt of the Notice to Proceed, the Contractor shall provide the Project Manager a list of the subcontractors.

#### **1.39 MINIMUM HOURLY RATES OF WAGES**

The wage determination decision of the Secretary of Labor which is attached to these specifications shall be applicable to this project in accordance with Davis-Bacon Act.

#### **1.40 FIELD QUALITY CONTROL**

NOTE: The following clause will be strictly enforced:

SUPERINTENDENT BY CONTRACTOR: See Specification Section 01 00 00 General Requirements, 1.1 General Intention, E. for requirements for the project Job Superintendent.

#### **1.41 KEYS AND BADGES**

The General Contractor will be issued all keys and badges. The General Contractor will be responsible for issuing keys to his subcontractors. Failing to return badges and keys will result in a reduction of the contract in the dollar amounts as follows:

Badges - \$50.00 for each badge not returned.

Keys - \$200.00 for each key not returned.

The total dollar amount of all keys and badges issued to the General Contractor will be retained until all keys and badges have been returned. If any keys or badges are not returned a permanent reduction in the contract dollar amount will occur.

#### **1.42 MSDS BOOK**

The General Contractor shall keep an MSDS book (soon to be called SDS book) on-site at all times for all hazardous materials used during work at the VA Medical Center. Upon request by the COTR, the General Contractor shall immediately provide the MSDS (SDS) book. The MSDS (SDS) book shall be submitted by the General Contractor at project close out and maintained with the COTR's project file.

#### **1.43 LOCKOUT / TAGOUT**

The Contractor shall follow OSHA and Mpls. VA Medical Center lockout/tag-out procedures. The contractor is responsible for having an equivalent procedure to protect both the vendor and VA personnel. In general it is expected that their procedures will conform to those of the VA policy. See COR for the complete VAMC LOTO policy (Facilities Engineering Services Memorandum no. 28). Provide COR with copies of all lockout/tag-out procedures prior to commencement of work.

Prior to performing lock-out tag-out on any device, the contractor must provide written notice to the COR stating what system will be locked out, system, location of lock-out, and person performing the work. This information must be recorded in the daily log and kept on each log until the lock is removed.

In the event of the installation of a new piece of equipment the Contractor shall provide the lock-out procedure for that piece of equipment and include in the O&M Manuals provided at project closeout.

**1.44 CONFINED SPACE ENTRY**

- A. The VA Medical Center Property has been surveyed for Permit Required Confined Spaces. An inventory of the spaces including the hazards and entry procedures are available from the Safety Manager. Entry may be required for the installation of electrical systems, controls, plumbing, pipe fitting and insulation as part of the project scope.
- B. Contractor shall be trained in confined space entry prior to entering confined space. Submit training records of all such employees for approval before start of work.
- C. All contractors and contractor employees entering a confined space shall follow OSHA and Minneapolis VA Medical Center Confined Space Entry procedures. Contractor shall obtain information regarding permit space hazards and coordinate entry operations with the Medical Center.
- D. Contractor shall inform the Medical Center of the permit space program that the contractor will follow and any hazards confronted or created in permit spaces during the entry operation.

**1.45 PROHIBITION ON ASBESTOS-CONTAINING MATERIALS**

The Contractor is prohibited from using any asbestos-containing materials on Mpls. VA Medical Center property.

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**SECTION 01 33 23**  
**SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

- 1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1-2. For the purposes of this contract, samples, test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
  - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
  - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
  - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion.
- 1-5. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by the Contracting Officer Representative (COR).
- 1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.
- 1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract.

- 1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer Representative and Architect- Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
- A. //Submit samples required by Section 09 06 00, SCHEDULE FOR FINISHES, in quadruplicate. Submit samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
- B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the // Medical Center, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
- C. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.

- D. Approved samples will be kept on file by the COR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.
- E. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.
1. For each drawing required, submit one legible photographic paper or vellum reproducible. Reproducible shall be full size.
  3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
  4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
  5. Submit drawings, WITH MAILING TUBE, fully protected for shipment.
  6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
  7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.
- 1-10. Samples and Submittals for approval shall be sent in care of:
- COR, Mark Angell (138), VA Medical Center,  
One Veteran's Drive  
Minneapolis, MN 55417  
OR Mark.Angell@VA.gov

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**SECTION 01 33 24**  
**ELECTRONIC SUBMITTAL PROCEDURES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies requirements for provision and use of an electronic, web-based service for submittal and tracking of construction submittals for the Project.

**1.2 REFERENCED DOCUMENTS**

- A. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

**1.3 SUMMARY:**

- A. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
- B. Shop drawing and product data submittals shall be transmitted to Architect in electronic (PDF) format using a web-based service designed specifically for transmitting and tracking submittals between construction team members.
- C. The electronic submittal process is not intended for color samples, color charts, or physical material samples.

**1.4 GENERAL DESCRIPTION OF PROCEDURES:**

- A. Submittal Preparation - Contractor may use any or all of the following options:
  - 1. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the submittal exchange website.
  - 2. Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format.
  - 3. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
- B. Contractor shall review, comment, and apply electronic stamp certifying that the submittal (as noted) complies with the requirements of the Contract Documents including verification of

manufacturer / product, dimensions and coordination of information with other parts of the work.

- C. Contractor shall transmit each submittal to Architect and Owner (simultaneously) using the web-based submittal exchange service.
- D. Architect / Engineer review comments will be made available on web-based submittal exchange service. Contractor shall receive email notice of completed review.
- E. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.

#### **1.5 REQUIREMENTS AND RESPONSIBILITIES**

- A. Submittal Exchange Service shall provide:
  - 1. Web-based tracking and approval system.
  - 2. Automated email notice for new submittals and reminders for submittals approaching the review deadline.
  - 3. Tracking and exchange of ITC/RFI/CO's and other similar document as well as product and equipment submittals.
  - 4. Means for tracking of the status such documents including whether they have been approved and released by the Owner.
  - 5. Organized storage of submittals that is accessible for review by the designated construction team members at any time.
  - 6. Submit a complete set of submittal on CD to the Owner at the end of the Project. Include all submittals included product submittals, shop drawings, ITC/RFI/CO's and other similar submittals.
- B. Contractor responsibilities:
  - 1. Contractor shall pay the cost of the service.
    - a. The cost of services shall be paid in full by the Contractor. Contractor shall include the full cost of the service and all related costs in their proposal.
    - b. Training in the use of the service by the team members shall be at the option of the Contractor and, if chosen, shall be paid by the Contractor
  - 2. Contractor shall have or obtain required hardware and software: Internet Service and Equipment Requirements:



- a. Email address and Internet access at Contractor's main office.
  - b. Adobe Acrobat ([www.adobe.com](http://www.adobe.com)), Bluebeam PDF Revu ([www.bluebeam.com](http://www.bluebeam.com)), or other similar PDF review software for applying electronic stamps and comments.
3. Contractor shall prepare or have prepared all required submittals in the PDF format required.
- a. PDF files must be readable. As a general rule, a resolution of 300 dpi should be used.
  - b. If the Architect can download more readable product data directly from the manufacturer's website than was submitted by the Contractor, the Architect shall reserve the right to reject the submittal.
4. Other responsibilities for submittals shall be as described in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- a. Color samples, color charts, or physical material samples shall be submitted as described in Section 01 33 23.

**1.6 ACCEPTABLE SERVICES**

- A. Service must be pre-approved by the Owner.
- B. The Contractor may submit any service meeting these requirements for approval.
- C. The following services have been pre-approved:
  - 1. NewForma InfoExchange 603-605-6212 [www.newforma.com](http://www.newforma.com)

- - - END - - -

**SECTION 01 35 26**  
**SAFETY REQUIREMENTS**

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**SECTION 01 35 26**  
**SAFETY REQUIREMENTS**

**1.1 APPLICABLE PUBLICATIONS:**

A. Latest publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.

B. American Society of Safety Engineers (ASSE):

A10.1-2011.....Pre-Project & Pre-Task Safety and Health  
Planning

A10.34-2012.....Protection of the Public on or Adjacent to  
Construction Sites

A10.38-2013.....Basic Elements of an Employer's Program to  
Provide a Safe and Healthful Work Environment  
American National Standard Construction and  
Demolition Operations

C. American Society for Testing and Materials (ASTM):

E84-2013.....Surface Burning Characteristics of Building  
Materials

D. The Facilities Guidelines Institute (FGI):

FGI Guidelines-2010Guidelines for Design and Construction of  
Healthcare Facilities

E. National Fire Protection Association (NFPA):

10-2013.....Standard for Portable Fire Extinguishers

30-2012.....Flammable and Combustible Liquids Code

51B-2014.....Standard for Fire Prevention During Welding,  
Cutting and Other Hot Work

70-2014.....National Electrical Code

70B-2013.....Recommended Practice for Electrical Equipment  
Maintenance

70E-2012 .....Standard for Electrical Safety in the Workplace

99-2012.....Health Care Facilities Code

241-2013.....Standard for Safeguarding Construction,  
Alteration, and Demolition Operations

F. The Joint Commission (TJC)

TJC Manual .....Comprehensive Accreditation and Certification  
Manual

G. U.S. Nuclear Regulatory Commission

10 CFR 20 .....Standards for Protection Against Radiation

H. U.S. Occupational Safety and Health Administration (OSHA):

29 CFR 1904 .....Reporting and Recording Injuries & Illnesses

29 CFR 1910 .....Safety and Health Regulations for General  
Industry

29 CFR 1926 .....Safety and Health Regulations for Construction  
Industry

CPL 2-0.124.....Multi-Employer Citation Policy

I. VHA Directive 2005-007

**1.2 DEFINITIONS:**

- A. OSHA "Competent Person" (CP). One who is capable of identifying existing and predictable hazards in the surroundings and working conditions which are unsanitary, hazardous or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them (see 29 CFR 1926.32(f)).
- B. "Qualified Person" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.
- C. High Visibility Accident. Any mishap which may generate publicity or high visibility.
- D. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.
- E. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:
1. Death, regardless of the time between the injury and death, or the length of the illness;
  2. Days away from work (any time lost after day of injury/illness onset);
  3. Restricted work;
  4. Transfer to another job;
  5. Medical treatment beyond first aid;
  6. Loss of consciousness; or

7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

**1.3 REGULATORY REQUIREMENTS:**

- A. In addition to the detailed requirements included in the provisions of this contract, comply with 29 CFR 1926, comply with 29 CFR 1910 as incorporated by reference within 29 CFR 1926, comply with ASSE A10.34, and all applicable [federal, state, and local] laws, ordinances, criteria, rules and regulations [\_\_\_\_\_]. Submit matters of interpretation of standards for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern except with specific approval and acceptance by the Contracting Officer Representative or Government Designated Authority.

**1.4 ACCIDENT PREVENTION PLAN (APP):**

- A. The APP (aka Construction Safety & Health Plan) shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and ensure it is site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all worksite safety and health of each subcontractor(s). Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.
- B. The APP shall be prepared as follows:
1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.
  2. Address both the Prime Contractors and the subcontractors work operations.

3. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.
4. Address all the elements/sub-elements and in order as follows:
  - a. **SIGNATURE SHEET.** Title, signature, and phone number of the following:
    - 1) Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);
    - 2) Plan approver (company/corporate officers authorized to obligate the company);
    - 3) Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).
  - b. **BACKGROUND INFORMATION.** List the following:
    - 1) Contractor;
    - 2) Contract number;
    - 3) Project name;
    - 4) Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).
  - c. **STATEMENT OF SAFETY AND HEALTH POLICY.** Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.
  - d. **RESPONSIBILITIES AND LINES OF AUTHORITIES.** Provide the following:
    - 1) A statement of the employer's ultimate responsibility for the implementation of his SOH program;
    - 2) Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.

- 3) The names of Competent and/or Qualified Person(s) and proof of competency/qualification to meet specific OSHA Competent/Qualified Person(s) requirements must be attached.;
  - 4) Requirements that no work shall be performed unless a designated competent person is present on the job site;
  - 5) Requirements for pre-task Activity Hazard Analysis (AHAs);
  - 6) Lines of authority;
  - 7) Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified;
- e. SUBCONTRACTORS AND SUPPLIERS.** If applicable, provide procedures for coordinating SOH activities with other employers on the job site:
- 1) Identification of subcontractors and suppliers (if known);
  - 2) Safety responsibilities of subcontractors and suppliers.
- f. TRAINING.**
- 1) Site-specific SOH orientation training at the time of initial hire or assignment to the project for every employee before working on the project site is required.
  - 2) Mandatory training and certifications that are applicable to this project (e.g., explosive actuated tools, crane operator, rigger, crane signal person, fall protection, electrical lockout/NFPA 70E, machine/equipment lockout, confined space, etc...) and any requirements for periodic retraining/recertification are required.
  - 3) Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.
  - 4) OSHA 10-hour training is required for all workers on site and the OSHA 30-hour training is required for Trade Competent Persons (CPs)
- g. SAFETY AND HEALTH INSPECTIONS.**
- 1) Specific assignment of responsibilities for a minimum daily job site safety and health inspection during periods of work activity: Who will conduct (e.g., "Site Safety and Health CP"), proof of inspector's training/qualifications, when

inspections will be conducted, procedures for documentation, deficiency tracking system, and follow-up procedures.

- 2) Any external inspections/certifications that may be required (e.g., contracted CSP or CSHT)

**h. ACCIDENT INVESTIGATION & REPORTING.** The Contractor shall conduct mishap investigations of all OSHA Recordable Incidents. The APP shall include accident/incident investigation procedure & identify person(s) responsible to provide the following to the Contracting Officer Representative or Government Designated Authority:

- 1) Exposure data (man-hours worked);
- 2) Accident investigations, reports, and logs.

**i. PLANS (PROGRAMS, PROCEDURES) REQUIRED.** Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks in site-specific compliance and accident prevention plans. These Plans shall include but are not be limited to procedures for addressing the risks associates with the following:

- 1) Emergency response ;
- 2) Contingency for severe weather;
- 3) Fire Prevention ;
- 4) Medical Support;
- 5) Posting of emergency telephone numbers;
- 6) Prevention of alcohol and drug abuse;
- 7) Site sanitation (housekeeping, drinking water, toilets);
- 8) Night operations and lighting ;
- 9) Hazard communication program;
- 10) Welding/Cutting "Hot" work ;
- 11) Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);
- 12) General Electrical Safety
- 13) Hazardous energy control (Machine LOTO);
- 14) Site-Specific Fall Protection & Prevention;
- 15) Excavation/trenching;
- 16) Asbestos abatement;
- 17) Lead abatement;
- 18) Crane Critical lift;



- 19) Respiratory protection;
- 20) Health hazard control program;
- 21) Radiation Safety Program;
- 22) Abrasive blasting;
- 23) Heat/Cold Stress Monitoring;
- 24) Crystalline Silica Monitoring (Assessment);
- 25) Demolition plan (to include engineering survey);
- 26) Formwork and shoring erection and removal;
- 27) PreCast Concrete.

- C. Submit the APP to the Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.
- D. Once accepted by the Contracting Officer Representative or Government Designated Authority, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.
- E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer Representative or Government Designated Authority. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34) and the environment.

#### **1.5 ACTIVITY HAZARD ANALYSES (AHAS) :**

- A. AHAs are also known as Job Hazard Analyses, Job Safety Analyses, and Activity Safety Analyses. Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or sub-contractor is to perform the work, the Contractor(s) performing that work activity shall

prepare an AHA (Example electronic AHA forms can be found on the US Army Corps of Engineers web site)

- B. AHAs shall define the activities being performed and identify the work sequences, the specific anticipated hazards, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.
- C. Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer Representative or Government Designated Authority and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
  - 1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA and/or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.
  - 2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).
    - a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.
    - b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.
  - 3. Submit AHAs to the Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily

inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.
5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to the Contracting Officer Representative or Government Designated Authority.

**1.6 PRECONSTRUCTION CONFERENCE:**

- A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the preconstruction conference to gain a mutual understanding of its implementation. This includes the project superintendent, subcontractor superintendents, and any other assigned safety and health professionals.
- B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.
- C. Deficiencies in the submitted APP will be brought to the attention of the Contractor within 14 days of submittal, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

**1.7 "SITE SAFETY AND HEALTH OFFICER" (SSHO) AND "COMPETENT PERSON" (CP):**

- A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention Plan. Each subcontractor shall designate a minimum of one CP in

compliance with 29 CFR 1926.20 (b) (2) that will be identified as a CP to administer their individual safety programs.

- B. Further, all specialized Competent Persons for the work crews will be supplied by the respective contractor as required by 29 CFR 1926 (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).
- C. These Competent Persons can have collateral duties as the subcontractor's superintendent and/or work crew lead persons as well as fill more than one specialized CP role (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).
- D. The SSHO or an equally-qualified Designated Representative/alternate will maintain a presence on the site during construction operations in accordance with FAR Clause 52.236-6: *Superintendence by the Contractor*. CPs will maintain presence during their construction activities in accordance with above mentioned clause. A listing of the designated SSHO and all known CPs shall be submitted prior to the start of work as part of the APP with the training documentation and/or AHA as listed in Section 1.8 below.
- E. The repeated presence of uncontrolled hazards during a contractor's work operations will result in the designated CP as being deemed incompetent and result in the required removal of the employee in accordance with FAR Clause 52.236-5: Material and Workmanship, Paragraph (c).

#### **1.8 TRAINING:**

- A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety class and have five (5) years of construction industry safety experience or three (3) years if he/she possesses a Certified Safety Professional (CSP) or certified Construction Safety and Health Technician (CSHT) certification or have a safety and health degree from an accredited university or college.

- B. All designated CPs shall have completed the OSHA 30-hour Construction Safety course within the past 5 years.
- C. In addition to the OSHA 30 Hour Construction Safety Course, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented "repeat" deficiencies in the execution of safety requirements will require retaking the requisite formal course.
- D. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.
- E. Submit training records associated with the above training requirements to the Contracting Officer Representative or Government Designated Authority for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance.
- F. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the Contracting Officer Representative that individuals have undergone contractor's safety briefing.
- G. Ongoing safety training will be accomplished in the form of weekly documented safety meeting.

#### **1.9 INSPECTIONS:**

- A. The SSHO shall conduct frequent and regular safety inspections (daily) of the site and each of the subcontractors CPs shall conduct frequent and regular safety inspections (daily) of the their work operations as required by 29 CFR 1926.20(b)(2). Each week, the SSHO shall conduct a formal documented inspection of the entire construction areas with the subcontractors' "Trade Safety and Health CPs" present in their work

areas. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative Government Designated Authority.

**1.10 ACCIDENTS, OSHA 300 LOGS, AND MAN-HOURS:**

- A. Notify the Contracting Officer Representative or Government Designated Authority as soon as practical, but no more than four hours after any accident meeting the definition of OSHA Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$5,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Contracting Officer Representative or Government Designated Authority determine whether a government investigation will be conducted.
- B. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, and property damage accidents resulting in at least \$20,000 in damages, to establish the root cause(s) of the accident. Complete the VA Form 2162, and provide the report to the Contracting Officer Representative or Government Designated Authority within 5 calendar days of the accident. The Contracting Officer Representative or Government Designated Authority will provide copies of any required or special forms.
- C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the Contracting Officer Representative Government Designated Authority monthly.
- D. A summation of all OSHA recordable accidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the Contracting Officer Representative or Government Designated Authority monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the Contracting Officer Representative or Government Designated Authority as requested.

**1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE) :**

- A. PPE is governed in all areas by the nature of the work the employee is performing. For example, specific PPE required for performing work on electrical equipment is identified in NFPA 70E, Standard for Electrical Safety in the Workplace.
- B. Mandatory PPE includes:
  - 1. Hard Hats - unless written authorization is given by the Contracting Officer Representative or Government Designated Authority in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA regulations.
  - 2. Safety glasses - unless written authorization is given by the Contracting Officer Representative or Government Designated Authority appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.
  - 3. Appropriate Safety Shoes - based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the Contracting Officer Representative or Government Designated Authority.
  - 4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

**1.12 INFECTION CONTROL**

- A. Infection Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust, or creating new dust, must be conducted within ventilation-controlled areas that minimize the flow of airborne particles into patient areas.
- B. An AHA associated with infection control will be performed by VA personnel in accordance with FGI Guidelines (i.e. Infection Control Risk Assessment (ICRA)). The ICRA procedure found on the American Society for Healthcare Engineering (ASHE) website will be utilized. Risk classifications of Class II or lower will require approval by the Contracting Officer Representative or Government Designated Authority

before beginning any construction work. Risk classifications of Class III or higher will require a permit before beginning any construction work. Infection Control permits will be issued by the Contracting Officer Representative. The Infection Control Permits will be posted outside the appropriate construction area. More than one permit may be issued for a construction project if the work is located in separate areas requiring separate classes. The primary project scope area for this project is: **Class IV**, however, work outside the primary project scope area may vary. The required infection control precautions with each class are as follows:

1. Class I requirements:

a. During Construction Work:

- 1) Notify the Contracting Officer Representative
- 2) Execute work by methods to minimize raising dust from construction operations.
- 3) Ceiling tiles: Immediately replace a ceiling tiles displaced for visual inspection.

b. Upon Completion:

- 1) Clean work area upon completion of task
- 2) Notify the Contracting Officer Representative

2. Class II requirements:

a. During Construction Work:

- 1) Notify the Contracting Officer Representative
- 2) Provide active means to prevent airborne dust from dispersing into atmosphere such as wet methods or tool mounted dust collectors where possible.
- 3) Water mist work surfaces to control dust while cutting.
- 4) Seal unused doors with duct tape.
- 5) Block off and seal air vents.
- 6) Remove or isolate HVAC system in areas where work is being performed.

b. Upon Completion:

- 1) Wipe work surfaces with cleaner/disinfectant.
- 2) Contain construction waste before transport in tightly covered containers.
- 3) Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.



- 4) Upon completion, restore HVAC system where work was performed
  - 5) Notify the Contracting Officer Representative
3. Class III requirements:
- a. During Construction Work:
    - 1) Obtain permit from the Contracting Officer Representative
    - 2) Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.
    - 3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
    - 4) Maintain negative air pressure, 0.01 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration and monitored by the contractor.
    - 5) Contain construction waste before transport in tightly covered containers.
    - 6) Cover transport receptacles or carts. Tape covering unless solid lid.
  - b. Upon Completion:
    - 1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative and thoroughly cleaned by the VA Environmental Services Department.
    - 2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
    - 3) Vacuum work area with HEPA filtered vacuums.
    - 4) Wet mop area with cleaner/disinfectant.
    - 5) Upon completion, restore HVAC system where work was performed.
    - 6) Return permit to the Contracting Officer Representative
4. Class IV requirements:
- a. During Construction Work:

- 1) Obtain permit from the Contracting Officer Representative
- 2) Isolate HVAC system in area where work is being done to prevent contamination of duct system.
- 3) Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
- 4) Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
- 5) Seal holes, pipes, conduits, and punctures.
- 6) Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site.
- 7) All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.

b. Upon Completion:

- 1) Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative with thorough cleaning by the VA Environmental Services Dept.
  - 2) Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
  - 3) Contain construction waste before transport in tightly covered containers.
  - 4) Cover transport receptacles or carts. Tape covering unless solid lid.
  - 5) Vacuum work area with HEPA filtered vacuums.
  - 6) Wet mop area with cleaner/disinfectant.
  - 7) Upon completion, restore HVAC system where work was performed.
  - 8) Return permit to the Contracting Officer Representative
- Barriers shall be erected as required based upon classification (Class III & IV requires barriers) and shall be constructed as follows:

1. Class III and IV - closed door with masking tape applied over the frame and door is acceptable for projects that can be contained in a single room.
  2. Construction, demolition or reconstruction not capable of containment within a single room must have the following barriers erected and made presentable on hospital occupied side:
    - a. Class III & IV (where dust control is the only hazard, and an agreement is reached with the Contracting Officers Representative and Medical Center) - Airtight plastic barrier that extends from the floor to ceiling. Seams must be sealed with duct tape to prevent dust and debris from escaping
    - b. Class III & IV - Drywall barrier erected with joints covered or sealed to prevent dust and debris from escaping.
    - c. Class III & IV - Seal all penetrations in existing barrier airtight
    - d. Class III & IV - Barriers at penetration of ceiling envelopes, chases and ceiling spaces to stop movement air and debris
    - e. Class IV only - Anteroom or double entrance openings that allow workers to remove protective clothing or vacuum off existing clothing
    - f. Class III & IV - At elevators shafts or stairways within the field of construction, overlapping flap minimum of two feet wide of polyethylene enclosures for personnel access.
- C. Products and Materials:
1. Sheet Plastic: Fire retardant polystyrene, 6-mil thickness meeting local fire codes (for use only when permitted by contracting officer representative)
  2. Barrier Doors: Self Closing One-hour fire-rated solid core wood in steel frame, painted
  3. Dust proof drywall rated as required to maintain fire rating of the partition.
  4. High Efficiency Particulate Air-Equipped filtration machine rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Maintenance of equipment and

- replacement of the HEPA filters and other filters will be in accordance with manufacturer's instructions.
5. Exhaust Hoses: Heavy duty, flexible steel reinforced; Ventilation Blower Hose
  6. Adhesive Walk-off Mats: Provide minimum size mats of 24 inches x 36 inches
  7. Disinfectant: Hospital-approved disinfectant or equivalent product
  8. Portable Ceiling Access Module
- D. Before any construction on site begins, all contractor personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.
- E. A dust control program will be establish and maintained as part of the contractor's infection preventive measures in accordance with the FGI Guidelines for Design and Construction of Healthcare Facilities. Prior to start of work, prepare a plan detailing project-specific dust protection measures with associated product data, including periodic status reports, and submit to Contracting Officer Representative and Facility CSC for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- F. Medical center Infection Control personnel will monitor for airborne disease (e.g. aspergillosis) during construction. A baseline of conditions will be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality with safe thresholds established.
- H. In general, the following preventive measures shall be adopted during construction to keep down dust and prevent mold.
1. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. HEPA filtration is required where the exhaust dust may reenter the medical center.
  2. Exhaust hoses shall be exhausted so that dust is not reintroduced to the medical center.
  3. Adhesive Walk-off/Carpet Walk-off Mats shall be used at all interior transitions from the construction area to occupied medical center

- area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.
4. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as it is created. Transport these outside the construction area in containers with tightly fitting lids.
  5. The contractor shall not haul debris through patient-care areas without prior approval of the Contracting Officer Representative and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.
  6. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.
  7. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.
- I. Final Cleanup:
1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
  2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
  3. All new air ducts shall be cleaned prior to final inspection.
- J. Exterior Construction
1. Contractor shall verify that dust will not be introduced into the medical center through intake vents, or building openings. HEPA filtration on intake vents is required where dust may be introduced.

2. Dust created from disturbance of soil such as from vehicle movement will be wetted with use of a water truck as necessary
3. All cutting, drilling, grinding, sanding, or disturbance of materials shall be accomplished with tools equipped with either local exhaust ventilation (i.e. vacuum systems) or wet suppression controls.

**1.13 TUBERCULOSIS SCREENING- NOT USED**

**1.14 FIRE SAFETY**

- A. Fire Safety Plan: Establish and maintain a site-specific fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.
- B. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- D. Temporary Construction Partitions:
  1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas and adjoining areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire retardant treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
  2. Install fire-rated temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
  3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.

- E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Contracting Officer Representative.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Contracting Officer Representative.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- K. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.
- L. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with Contracting Officer Representative. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the Contracting Officer Representative.
- M. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Contracting Officer Representative.
- N. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer Representative. Obtain permits from contracting officer representative at least 2 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- O. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative.

- P. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- Q. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.

#### **1.15 ELECTRICAL**

- A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J - General Environmental Controls, 29 CFR Part 1910 Subpart S - Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.
- B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.
- C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition ( refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards, or is infeasible due to equipment design or operational limitations is energized work permitted. The Chief of Facilities Management and Contracting Officer Representative Government Designated Authority with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA specific to energized work activities will be developed, reviewed, and accepted prior to the start of that work.
  - 1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.



2. Verification of the absence of voltage after de-energization and lockout/tagout is considered "energized electrical work" (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.
  3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the The Contracting Officer Representative.
- D.** Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alternative and it is strongly suggested a full Arc Flash Hazard Analyses be conducted). Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer Representative and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
- E.** Ground-fault circuit interrupters. All 120-volt, single-phase 15- and 20-ampere receptacle outlets on construction sites shall have approved ground-fault circuit interrupters for personnel protection. "Assured Equipment Grounding Conductor Program" only is not allowed.

#### **1.16 FALL PROTECTION**

- A.** The fall protection (FP) threshold height requirement is 6 ft (1.8 m) for ALL WORK, unless specified differently or the OSHA 29 CFR 1926 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work.
1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
  2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
  3. A Warning Line System (WLS) may ONLY be used on floors or flat or low-sloped roofs (between 0 - 18.4 degrees or 4:12 slope) and shall be erected around all sides of the work area (See 29 CFR 1926.502(f))

for construction of WLS requirements). Working within the WLS does not require FP. No worker shall be allowed in the area between the roof or floor edge and the WLS without FP. FP is required when working outside the WLS.

4. Fall protection while using a ladder will be governed by the OSHA requirements.

**1.17 SCAFFOLDS AND OTHER WORK PLATFORMS- NOT APPLICABLE**

**1.18 EXCAVATION AND TRENCHES- NOT APPLICABLE**

**1.19 CRANES- NOT APPLICABLE**

**1.20 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)**

- A. All installation, maintenance, and servicing of equipment or machinery shall comply with 29 CFR 1910.147 except for specifically referenced operations in 29 CFR 1926 such as concrete & masonry equipment [1926.702(j)], heavy machinery & equipment [1926.600(a)(3)(i)], and process safety management of highly hazardous chemicals (1926.64). Control of hazardous electrical energy during the installation, maintenance, or servicing of electrical equipment shall comply with Section 1.15 to include NFPA 70E and other VA specific requirements discussed in the section.

**1.21 CONFINED SPACE ENTRY**

- A. All confined space entry shall comply with 29 CFR 1910.146 except for specifically referenced operations in 29 CFR 1926 such as excavations/trenches [1926.651(g)].
- B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the Contracting Officer Representative.

**1.22 WELDING AND CUTTING**

As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer Representative. Obtain permits from contracting officer representative at least 4 hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

**1.23 LADDERS**

- A. All Ladder use shall comply with 29 CFR 1926 Subpart X.
- B. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.

- C. Manufacturer safety labels shall be in place on ladders
- D. Step Ladders shall not be used in the closed position
- E. Top steps or cap of step ladders shall not be used as a step
- F. Portable ladders, used as temporary access, shall extend at least 3 ft (0.9 m) above the upper landing surface.
  - 1. When a 3 ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.
  - 2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.
- G. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use. Broken or damaged ladders shall be immediately tagged "DO NOT USE," or with similar wording, and withdrawn from service until restored to a condition meeting their original design.

#### **1.24 FLOOR & WALL OPENINGS**

- A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.
- B. Floor and roof holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. See 21.F for covering and labeling requirements. Skylights located in floors or roofs are considered floor or roof hole/openings.
- C. All floor, roof openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with toeboards along all exposed sides or a load-bearing cover. When the cover is not in place, the opening or hole shall be protected by a removable guardrail system or shall be attended when the guarding system has been removed, or other fall protection system.
  - 1. Covers shall be capable of supporting, without failure, at least twice the weight of the worker, equipment and material combined.
  - 2. Covers shall be secured when installed, clearly marked with the word "HOLE", "COVER" or "Danger, Roof Opening-Do Not Remove" or color-coded or equivalent methods (e.g., red or orange "X"). Workers must be made aware of the meaning for color coding and equivalent methods.

3. Roofing material, such as roofing membrane, insulation or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.
4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen, cover, or railing system along all exposed sides.
5. Workers are prohibited from standing/walking on skylights.

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**SECTION 01 42 19**  
**REFERENCE STANDARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

**1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)**

- A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to - GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.
- B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

**1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)**

The specifications and standards cited in this solicitation can be examined at the following location:

DEPARTMENT OF VETERANS AFFAIRS  
Office of Construction & Facilities Management  
Facilities Quality Service (00CFM1A)  
425 Eye Street N.W, (sixth floor)  
Washington, DC 20001  
Telephone Numbers: (202) 632-5249 or (202) 632-5178  
Between 9:00 AM - 3:00 PM

**1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)**

The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

AA	Aluminum Association Inc. <a href="http://www.aluminum.org">http://www.aluminum.org</a>
AABC	Associated Air Balance Council <a href="http://www.aabchg.com">http://www.aabchg.com</a>
AAMA	American Architectural Manufacturer's Association <a href="http://www.aamanet.org">http://www.aamanet.org</a>
AAN	American Nursery and Landscape Association <a href="http://www.anla.org">http://www.anla.org</a>
AASHTO	American Association of State Highway and Transportation Officials <a href="http://www.aashto.org">http://www.aashto.org</a>
AATCC	American Association of Textile Chemists and Colorists <a href="http://www.aatcc.org">http://www.aatcc.org</a>
ACGIH	American Conference of Governmental Industrial Hygienists <a href="http://www.acgih.org">http://www.acgih.org</a>
ACI	American Concrete Institute <a href="http://www.aci-int.net">http://www.aci-int.net</a>
ACPA	American Concrete Pipe Association <a href="http://www.concrete-pipe.org">http://www.concrete-pipe.org</a>
ACPPA	American Concrete Pressure Pipe Association <a href="http://www.acppa.org">http://www.acppa.org</a>
ADC	Air Diffusion Council <a href="http://flexibleduct.org">http://flexibleduct.org</a>
AGA	American Gas Association <a href="http://www.aga.org">http://www.aga.org</a>
AGC	Associated General Contractors of America <a href="http://www.agc.org">http://www.agc.org</a>
AGMA	American Gear Manufacturers Association, Inc. <a href="http://www.agma.org">http://www.agma.org</a>
AHAM	Association of Home Appliance Manufacturers <a href="http://www.aham.org">http://www.aham.org</a>
AIA	American Institute of Architects

	<a href="http://www.aia.org">http://www.aia.org</a>
AISC	American Institute of Steel Construction <a href="http://www.aisc.org">http://www.aisc.org</a>
AISI	American Iron and Steel Institute <a href="http://www.steel.org">http://www.steel.org</a>
AITC	American Institute of Timber Construction <a href="http://www.aitc-glulam.org">http://www.aitc-glulam.org</a>
AMCA	Air Movement and Control Association, Inc. <a href="http://www.amca.org">http://www.amca.org</a>
ANLA	American Nursery & Landscape Association <a href="http://www.anla.org">http://www.anla.org</a>
ANSI	American National Standards Institute, Inc. <a href="http://www.ansi.org">http://www.ansi.org</a>
APA	The Engineered Wood Association <a href="http://www.apawood.org">http://www.apawood.org</a>
ARI	Air-Conditioning and Refrigeration Institute <a href="http://www.ari.org">http://www.ari.org</a>
ASAE	American Society of Agricultural Engineers <a href="http://www.asae.org">http://www.asae.org</a>
ASCE	American Society of Civil Engineers <a href="http://www.asce.org">http://www.asce.org</a>
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers <a href="http://www.ashrae.org">http://www.ashrae.org</a>
ASME	American Society of Mechanical Engineers <a href="http://www.asme.org">http://www.asme.org</a>
ASSE	American Society of Sanitary Engineering <a href="http://www.asse-plumbing.org">http://www.asse-plumbing.org</a>
ASTM	American Society for Testing and Materials <a href="http://www.astm.org">http://www.astm.org</a>
AWI	Architectural Woodwork Institute <a href="http://www.awinet.org">http://www.awinet.org</a>
AWS	American Welding Society <a href="http://www.aws.org">http://www.aws.org</a>
AWWA	American Water Works Association <a href="http://www.awwa.org">http://www.awwa.org</a>

BHMA	Builders Hardware Manufacturers Association <a href="http://www.buildershardware.com">http://www.buildershardware.com</a>
BIA	Brick Institute of America <a href="http://www.bia.org">http://www.bia.org</a>
CAGI	Compressed Air and Gas Institute <a href="http://www.cagi.org">http://www.cagi.org</a>
CGA	Compressed Gas Association, Inc. <a href="http://www.cganet.com">http://www.cganet.com</a>
CI	The Chlorine Institute, Inc. <a href="http://www.chlorineinstitute.org">http://www.chlorineinstitute.org</a>
CISCA	Ceilings and Interior Systems Construction Association <a href="http://www.cisca.org">http://www.cisca.org</a>
CISPI	Cast Iron Soil Pipe Institute <a href="http://www.cispi.org">http://www.cispi.org</a>
CLFMI	Chain Link Fence Manufacturers Institute <a href="http://www.chainlinkinfo.org">http://www.chainlinkinfo.org</a>
CPMB	Concrete Plant Manufacturers Bureau <a href="http://www.cpmc.org">http://www.cpmc.org</a>
CRA	California Redwood Association <a href="http://www.calredwood.org">http://www.calredwood.org</a>
CRSI	Concrete Reinforcing Steel Institute <a href="http://www.crsi.org">http://www.crsi.org</a>
CTI	Cooling Technology Institute <a href="http://www.cti.org">http://www.cti.org</a>
DHI	Door and Hardware Institute <a href="http://www.dhi.org">http://www.dhi.org</a>
EGSA	Electrical Generating Systems Association <a href="http://www.egsa.org">http://www.egsa.org</a>
EEI	Edison Electric Institute <a href="http://www.eei.org">http://www.eei.org</a>
EPA	Environmental Protection Agency <a href="http://www.epa.gov">http://www.epa.gov</a>
ETL	ETL Testing Laboratories, Inc. <a href="http://www.etl.com">http://www.etl.com</a>
FAA	Federal Aviation Administration <a href="http://www.faa.gov">http://www.faa.gov</a>



FCC	Federal Communications Commission <a href="http://www.fcc.gov">http://www.fcc.gov</a>
FPS	The Forest Products Society <a href="http://www.forestprod.org">http://www.forestprod.org</a>
GANA	Glass Association of North America <a href="http://www.cssinfo.com/info/gana.html/">http://www.cssinfo.com/info/gana.html/</a>
FM	Factory Mutual Insurance <a href="http://www.fmglobal.com">http://www.fmglobal.com</a>
GA	Gypsum Association <a href="http://www.gypsum.org">http://www.gypsum.org</a>
GSA	General Services Administration <a href="http://www.gsa.gov">http://www.gsa.gov</a>
HI	Hydraulic Institute <a href="http://www.pumps.org">http://www.pumps.org</a>
HPVA	Hardwood Plywood & Veneer Association <a href="http://www.hpva.org">http://www.hpva.org</a>
ICBO	International Conference of Building Officials <a href="http://www.icbo.org">http://www.icbo.org</a>
ICEA	Insulated Cable Engineers Association Inc. <a href="http://www.icea.net">http://www.icea.net</a>
\ICAC	Institute of Clean Air Companies <a href="http://www.icac.com">http://www.icac.com</a>
IEEE	Institute of Electrical and Electronics Engineers <a href="http://www.ieee.org/">http://www.ieee.org/</a>
IMSA	International Municipal Signal Association <a href="http://www.imsasafety.org">http://www.imsasafety.org</a>
IPCEA	Insulated Power Cable Engineers Association
NBMA	Metal Buildings Manufacturers Association <a href="http://www.mbma.com">http://www.mbma.com</a>
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry Inc. <a href="http://www.mss-hq.com">http://www.mss-hq.com</a>
NAAMM	National Association of Architectural Metal Manufacturers <a href="http://www.naamm.org">http://www.naamm.org</a>
NAPHCC	Plumbing-Heating-Cooling Contractors Association <a href="http://www.phccweb.org.org">http://www.phccweb.org.org</a>

NBS National Bureau of Standards  
See - NIST

NBBPVI National Board of Boiler and Pressure Vessel Inspectors  
<http://www.nationboard.org>

NEC National Electric Code  
See - NFPA National Fire Protection Association

NEMA National Electrical Manufacturers Association  
<http://www.nema.org>

NFPA National Fire Protection Association  
<http://www.nfpa.org>

NHLA National Hardwood Lumber Association  
<http://www.natlhardwood.org>

NIH National Institute of Health  
<http://www.nih.gov>

NIST National Institute of Standards and Technology  
<http://www.nist.gov>

NLMA Northeastern Lumber Manufacturers Association, Inc.  
<http://www.nelma.org>

NPA National Particleboard Association  
18928 Premiere Court  
Gaithersburg, MD 20879  
(301) 670-0604

NSF National Sanitation Foundation  
<http://www.nsf.org>

NWWDA Window and Door Manufacturers Association  
<http://www.nwwda.org>

OSHA Occupational Safety and Health Administration  
Department of Labor  
<http://www.osha.gov>

PCA Portland Cement Association  
<http://www.portcement.org>

PCI Precast Prestressed Concrete Institute  
<http://www.pci.org>

PPI The Plastic Pipe Institute  
<http://www.plasticpipe.org>

PEI Porcelain Enamel Institute, Inc.  
<http://www.porcelainenamel.com>

PTI Post-Tensioning Institute  
<http://www.post-tensioning.org>

RFCI The Resilient Floor Covering Institute  
<http://www.rfci.com>

RIS Redwood Inspection Service  
See - CRA

RMA Rubber Manufacturers Association, Inc.  
<http://www.rma.org>

SCMA Southern Cypress Manufacturers Association  
<http://www.cypressinfo.org>

SDI Steel Door Institute  
<http://www.steeldoor.org>

IGMA Insulating Glass Manufacturers Alliance  
<http://www.igmaonline.org>

SJI Steel Joist Institute  
<http://www.steeljoist.org>

SMACNA Sheet Metal and Air-Conditioning Contractors  
National Association, Inc.  
<http://www.smacna.org>

SSPC The Society for Protective Coatings  
<http://www.sspc.org>

STI Steel Tank Institute  
<http://www.steeltank.com>

SWI Steel Window Institute  
<http://www.steelwindows.com>

TCA Tile Council of America, Inc.  
<http://www.tileusa.com>

TEMA Tubular Exchange Manufacturers Association  
<http://www.tema.org>

TPI Truss Plate Institute, Inc.  
583 D'Onofrio Drive; Suite 200  
Madison, WI 53719  
(608) 833-5900

UBC The Uniform Building Code  
See ICBO

UL Underwriters' Laboratories Incorporated  
<http://www.ul.com>

ULC Underwriters' Laboratories of Canada  
<http://www.ulc.ca>

WCLIB West Coast Lumber Inspection Bureau  
6980 SW Varns Road, P.O. Box 23145  
Portland, OR 97223  
(503) 639-0651

WRCLA Western Red Cedar Lumber Association  
P.O. Box 120786  
New Brighton, MN 55112  
(612) 633-4334

WWPA Western Wood Products Association  
<http://www.wwpa.org>

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**SECTION 01 45 29**  
**TESTING LABORATORY SERVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained by Department of Veterans.

**1.2 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- C. American Concrete Institute (ACI):  
506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete
- D. American Society for Testing and Materials (ASTM):  
A325-10.....Standard Specification for Structural Bolts,  
Steel, Heat Treated, 120/105 ksi Minimum Tensile  
Strength  
A370-12.....Standard Test Methods and Definitions for  
Mechanical Testing of Steel Products  
A416/A416M-10.....Standard Specification for Steel Strand,  
Uncoated Seven-Wire for Prestressed Concrete  
A490-12.....Standard Specification for Heat Treated Steel  
Structural Bolts, 150 ksi Minimum Tensile  
Strength  
C31/C31M-10.....Standard Practice for Making and Curing Concrete  
Test Specimens in the Field  
C33/C33M-11a.....Standard Specification for Concrete Aggregates  
C39/C39M-12.....Standard Test Method for Compressive Strength of  
Cylindrical Concrete Specimens  
C109/C109M-11b.....Standard Test Method for Compressive Strength of  
Hydraulic Cement Mortars  
C136-06.....Standard Test Method for Sieve Analysis of Fine  
and Coarse Aggregates  
C138/C138M-10b.....Standard Test Method for Density (Unit Weight),  
Yield, and Air Content (Gravimetric) of Concrete  
C140-12.....Standard Test Methods for Sampling and Testing  
Concrete Masonry Units and Related Units  
C143/C143M-10a.....Standard Test Method for Slump of Hydraulic  
Cement Concrete

C172/C172M-10.....Standard Practice for Sampling Freshly Mixed  
Concrete  
C173/C173M-10b.....Standard Test Method for Air Content of freshly  
Mixed Concrete by the Volumetric Method  
C330/C330M-09.....Standard Specification for Lightweight  
Aggregates for Structural Concrete  
C567/C567M-11.....Standard Test Method for Density Structural  
Lightweight Concrete  
C780-11.....Standard Test Method for Pre-construction and  
Construction Evaluation of Mortars for Plain and  
Reinforced Unit Masonry  
C1019-11.....Standard Test Method for Sampling and Testing  
Grout  
C1064/C1064M-11.....Standard Test Method for Temperature of Freshly  
Mixed Portland Cement Concrete  
C1077-11c.....Standard Practice for Agencies Testing Concrete  
and Concrete Aggregates for Use in Construction  
and Criteria for Testing Agency Evaluation  
E94-04 (2010).....Standard Guide for Radiographic Examination  
E164-08.....Standard Practice for Contact Ultrasonic Testing  
of Weldments  
E329-11c.....Standard Specification for Agencies Engaged in  
Construction Inspection, Testing, or Special  
Inspection  
E543-09.....Standard Specification for Agencies Performing  
Non-Destructive Testing  
E605-93 (R2011).....Standard Test Methods for Thickness and Density  
of Sprayed Fire Resistive Material (SFRM)  
Applied to Structural Members  
E1155-96 (R2008).....Determining FF Floor Flatness and FL Floor  
Levelness Numbers

E. American Welding Society (AWS):

D1.D1.1M-10.....Structural Welding Code-Steel

### **1.3 REQUIREMENTS:**

A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications.

Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."

- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by Resident Engineer. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of Resident Engineer to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to Resident Engineer, Contractor, unless other arrangements are agreed to in writing by the Resident Engineer. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to Resident Engineer immediately of any irregularity.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 STRUCTURAL STEEL:**

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.
- B. Prefabrication Inspection:
  - 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
  - 2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
  - 3. Approve welder qualifications by certification or retesting.
  - 4. Approve procedure for control of distortion and shrinkage stresses.
  - 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.
- C. Fabrication and Erection:
  - 1. Weld Inspection:
    - a. Inspect welding equipment for capacity, maintenance and working condition.
    - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
    - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.

- d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
  - e. Measure 25 percent of fillet welds.
  - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
    - 1) 20 percent of all shear plate fillet welds at random, final pass only.
    - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
    - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
    - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
    - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
  - h. Welding Radiographic Testing: Test in accordance with ASTM E94, and AWS D1.1 for 5 percent of all full penetration welds at random.
  - i. Verify that correction of rejected welds are made in accordance with AWS D1.1.
  - j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
  - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
  - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.



- d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
- e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
- f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to Resident Engineer.

### **3.2 SPRAYED-ON FIREPROOFING:**

- A. Provide field inspection and testing services to certify sprayed-on fireproofing has been applied in accordance with contract documents.
- B. Obtain a copy of approved submittals from Resident Engineer.
- C. Use approved installation in test areas as criteria for inspection of work.
- D. Test sprayed-on fireproofing for thickness and density in accordance with ASTM E605.
  - 1. Thickness gauge specified in ASTM E605 may be modified for pole extension so that overhead sprayed material can be reached from floor.
- E. Location of test areas for field tests as follows:
  - 1. Thickness: Select one bay per floor, or one bay for each 930 m<sup>2</sup> (10,000 square feet) of floor area, whichever provides for greater number of tests. Take thickness determinations from each of following locations: Metal deck, beam, and column.
  - 2. Density: Take density determinations from each floor, or one test from each 930 m<sup>2</sup> (10,000 square feet) of floor area, whichever provides for greater number of tests, from each of the following areas: Underside of metal deck, beam flanges, and beam web.
- F. Submit inspection reports, certification, and instances of noncompliance to Resident Engineer.

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**SECTION 01 58 16**  
**TEMPORARY INTERIOR SIGNAGE**

**PART 1 GENERAL**

**DESCRIPTION**

This section specifies temporary interior signs.

**PART 2 PRODUCTS**

**2.1 TEMPORARY SIGNS**

- A. Fabricate from 50 Kg (110 pound) mat finish white paper.
- B. Cut to 100 mm (4-inch) wide by 300 mm (12 inch) long size tag.
- C. Punch 3 mm (1/8-inch) diameter hole centered on 100 mm (4-inch) dimension of tag. Edge of Hole spaced approximately 13 mm (1/2-inch) from one end on tag.
- D. Reinforce hole on both sides with gummed cloth washer or other suitable material capable of preventing tie pulling through paper edge.
- E. Ties: Steel wire 0.3 mm (0.0120-inch) thick, attach to tag with twist tie, leaving 150 mm (6-inch) long free ends.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- A. Install temporary signs attached to room door frame or room door knob, lever, or pull for doors on corridor openings.
- B. Mark on signs with felt tip marker having approximately 3 mm (1/8-inch) wide stroke for clearly legible numbers or letters.
- C. Identify room with numbers as designated on floor plans.

**3.2 LOCATION**

- A. Install on doors that have room, corridor, and space numbers shown.
- B. Doors that do not require signs are as follows:
  - 1. Corridor barrier doors (cross-corridor) in corridor with same number.
  - 2. Folding doors or partitions.
  - 3. Toilet or bathroom doors within and between rooms.
  - 4. Communicating doors in partitions between rooms with corridor entrance doors.
  - 5. Closet doors within rooms.
- C. Replace missing, damaged, or illegible signs.

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**SECTION 01 74 19**  
**CONSTRUCTION WASTE MANAGEMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.
- B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.
- C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:
  - 1. Waste Management Plan development and implementation.
  - 2. Techniques to minimize waste generation.
  - 3. Sorting and separating of waste materials.
  - 4. Salvage of existing materials and items for reuse or resale.
  - 5. Recycling of materials that cannot be reused or sold.
- D. At a minimum the following waste categories shall be diverted from landfills:
  - 1. Soil.
  - 2. Inerts (eg, concrete, masonry and asphalt).
  - 3. Clean dimensional wood and palette wood.
  - 4. Green waste (biodegradable landscaping materials).
  - 5. Engineered wood products (plywood, particle board and I-joists, etc).
  - 6. Metal products (eg, steel, wire, beverage containers, copper, etc).
  - 7. Cardboard, paper and packaging.
  - 8. Bitumen roofing materials.
  - 9. Plastics (eg, ABS, PVC).
  - 10. Carpet and/or pad.
  - 11. Gypsum board.
  - 12. Insulation.
  - 13. Paint.
  - 14. Fluorescent lamps.

**1.2 RELATED WORK**

- A. Section 02 41 00, DEMOLITION.
- B. Section 01 00 00, GENERAL REQUIREMENTS.

### **1.3 QUALITY ASSURANCE**

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
  - 1. Excess or unusable construction materials.
  - 2. Packaging used for construction products.
  - 3. Poor planning and/or layout.
  - 4. Construction error.
  - 5. Over ordering.
  - 6. Weather damage.
  - 7. Contamination.
  - 8. Mishandling.
  - 9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to reuse and recycle new materials to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.wbdg.org> provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

#### **1.4 TERMINOLOGY**

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.
- B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.
- C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.
- D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.
- E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).
- F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.
- G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.

- K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.
- L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
1. On-site Recycling - Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
  2. Off-site Recycling - Materials hauled to a location and used in an altered form in the manufacture of new products.
- M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.
- N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.
- O. Return: To give back reusable items or unused products to vendors for credit.
- P. Salvage: To remove waste materials from the site for resale or re-use by a third party.
- Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.
- R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.
- S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

#### **1.5 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:

- B. Prepare and submit to the COR a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
1. Procedures to be used for debris management.
  2. Techniques to be used to minimize waste generation.
  3. Analysis of the estimated job site waste to be generated:
    - a. List of each material and quantity to be salvaged, reused, recycled.
    - b. List of each material and quantity proposed to be taken to a landfill.
  4. Detailed description of the Means/Methods to be used for material handling.
    - a. On site: Material separation, storage, protection where applicable.
    - b. Off site: Transportation means and destination. Include list of materials.
      - 1) Description of materials to be site-separated and self-hauled to designated facilities.
      - 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
    - c. The names and locations of mixed debris reuse and recycling facilities or sites.
    - d. The names and locations of trash disposal landfill facilities or sites.
    - e. Documentation that the facilities or sites are approved to receive the materials.
- C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.
- B. U.S. Green Building Council (USGBC):

LEED Green Building Rating System for New Construction

**1.7 RECORDS**

Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and LEED Template.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. List of each material and quantity to be salvaged, recycled, reused.
- B. List of each material and quantity proposed to be taken to a landfill.
- C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

**PART 3 - EXECUTION**

**3.1 COLLECTION**

- A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.
- C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

**3.2 DISPOSAL**

- A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.
- B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

**3.3 REPORT**

- A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.
- B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed,



transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.

- C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

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**SECTION 02 41 00**  
**DEMOLITION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies demolition and removal of portions of buildings, utilities, other structures and materials.

**1.2 RELATED WORK:**

- A. Disconnecting and removal of identified utilities.
- B. Construction Waste Management: Section 017419 CONSTRUCTION WASTE MANAGEMENT.
- C. Infectious Control: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.8, INFECTION PREVENTION MEASURES.

**1.3 PROTECTION:**

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.
- E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
- F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
  - 1. No wall or part of wall shall be permitted to fall outwardly from structures.

2. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
  3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- G. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the Resident Engineer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR's approval.
- H. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.8 INFECTION PREVENTION MEASURES.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 PREPARATION:**

- A. Provide and maintain temporary barriers.
- B. Provide negative air filtration in areas of construction. Provide HEPA filtration and duct to building exhaust system.
- C. Erect and maintain temporary partitions to prevent spread of dust, odors and noise to permit continued Owner occupancy.
- D. Protect existing materials and equipment that are not to be demolished.
- E. Prevent movement of structure; provide required bracing and shoring.
- F. Mark location and termination of utilities.
- G. Provide appropriate temporary signage including signage for exit or building egress.
- H. Notify affected utility companies before starting work and comply with their requirements.

**3.2 DEMOLITION:**

- A. Disconnect, remove, cap, and identify designated utilities within demolition areas.
- B. Demolish in an orderly and careful manner. Protect existing supporting structural members.
- C. Demolish concrete and masonry in small sections. Cut perimeter of areas to be removed with saws.
- D. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- E. Remove materials from site as work progresses. Upon completion of work, leave areas in clean condition.
- F. Remove temporary Work.
- G. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COR. Clean-up shall include off the Medical Center property disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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**SECTION 03 55 11**  
**GYPSUM CONCRETE FLOOR DECKS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies gypsum plank systems for fire rated interstitial decks

**1.2 RELATED WORK**

- A. Steel Framing: Section 05 12 00, STRUCTURAL STEEL FRAMING
- B. Sealer for interstitial floor and floor paint for traffic area in interstitial space: Section 09 91 00, PAINTING.

**1.3 QUALITY CONTROL**

- A. Work performed by experienced, qualified installers approved by manufacturer of gypsum plank.
- B. Gypsum materials products of one manufacturer.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Fire Tests: Fire tests, data and certifications substantiating that Gypsum Plank Decking complies with fire rating requirements.
- C. Shop Drawings: Show beam, bulb tee / angle layout, typical form type and layouts, perimeter and framed opening supports and details of construction, installation, fastenings and grouting.
- D. Manufacturer's Literature and Data: Each item specified.

**1.5 DELIVERY AND STORAGE**

- A. Deliver materials in original packages, containers, or bundles bearing brand name and name of manufacturer.
- B. Store materials in a manner that prevents damage before use. When stored under tarpaulins, provide ventilation to prevent moisture accumulation under tarpaulin.
- C. Store gypsum plank forms flat and off ground. Handle and stack in a manner to prevent damage to face, ends, and edges and keep dry until used.
- D. Store gypsum concrete off ground and keep dry until used.

**1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designations only.
- B. American Society for Testing and Materials (ASTM):

A36/A36M-08.....Standard Specifications for Carbon Structural  
Steel  
A82-07.....Standard Specifications for Steel Wire, Plain,  
for Concrete Reinforcement  
A185/185M-07.....Standard Specification for Steel Welded Wire  
Reinforcement, Plain, for Concrete  
A499-89 (R2008).....Standard Specifications for Steel Bars and  
Shapes, Carbon Rolled from "T" Rails  
A568/A568M-09.....Standard specification for Steel, Sheet, Carbon,  
Structural and High-Strength, Low-Alloy, Hot-  
Rolled and Cold-Rolled General Requirements for  
A653/A653M-10.....Standard Specification for Steel Sheet, Zinc-  
Coated (Galvanized) or Zinc-Iron Alloy-coated  
(Galvannealed) by the Hot-Dip Process  
C317/C317M-00 (R2010)....Standard specification for Gypsum Concrete  
C1396/C1396M-09.....Standard Specification for Gypsum Board  
E119-10.....Standard Test Methods for Fire Tests of Building  
Construction and Materials

C. American Welding Society Publication (AWS):

D1.1/D1.1M-10.....Structural Welding Code - Steel

**1.7 PRECONSTRUCTION TESTING**

- A. Make 1 test panel 4' long x 5' wide with a minimum of 1 purlin/bulb tee, closure plates and W6x9 beams on each side of panel. Use only materials proposed for actual construction. Provide 1/8" bent closure plates at open ends of test panel. Stabilize assembly as required and to simulate actual field conditions. Test panel shall be poured with a minimum of 6" gap below panel.
- B. The test panel shall contain reinforcing typical of the work to be installed and other details to simulate actual job conditions. Finish sample panels as required for work to be installed. Sample panels must be approved by the V.A. before any work can begin. Contractor shall store sample panel on site and protect it continuously until substantial completion.
- C. Testing laboratory approved by the Resident Engineer and reimbursed by Contractor shall observe test panel prior to gypsum concrete pour and shall observe pouring of gypsum concrete. Testing laboratory shall test gypsum concrete for wet unit weight, compressive strength and density after 24 hours of curing.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Welded Wire Fabric: ASTM A185.
- B. Gypsum Deck Panels: ASTM C1396, Type "X", 16 mm (5/8-inch) thick by 600 mm (24-inches) wide by main purlin span.
- C. Grout: Gypsum Concrete: ASTM C317, Class A, 3.5 MPa (500 psi) minimum compressive strength, maximum density 60 pcf.
- D. Water: Fresh, Clean, and Potable

### **2.2 DECK SYSTEM**

- A. Interstitial deck: Provide two-hour fire rating as tested by Gypsum plank manufacturer under ASTM E119 fire test conditions modified to simulate the Department of Veterans Affairs Building System test described in National Institute of Standards and Technology Report NBSIR 85-3158, "Fire Performance of Interstitial Space Construction System".

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Examine substrates, framing and conditions under which gypsum plank is to be installed and notify Resident Engineer in writing of conditions detrimental to proper and timely completion.
- B. Do not proceed until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Weld per AWS D1.1.
- B. For Two Hour fire rated interstitial decks.
  - 1. Install beams, purlins/bulb tees and edge closure plates.
  - 2. Place gypsum deck panels on bottom flanges of sub-purlins with continuous bearing.
  - 3. Install reinforcing mesh with required bottom cover. Mesh shall be continuous with main wires spanning across purlins/bulb tees. Mesh shall be lapped a minimum of one full mesh spacing or 4", whichever is greater.
  - 4. Place gypsum concrete over gypsum deck panels.
  - 5. Installation to conform to fire test assembly.
- C. Provide continuous 16 mm (5/8-inch) minimum bearing for plank support at deck perimeter, plank ends and openings exceeding 150 mm (6-inches).
- D. Grout:
  - 1. Mix gypsum concrete thoroughly using a minimum amount of water to form a thick, pourable consistency.
  - 2. Test a minimum of two grout samples from each pour for compressive strength and cured density.

E. Patching:

1. Fill with grout and smooth any surface damage to gypsum floor.
2. Remove and replace cracked, broken, and damaged floor areas.

F. Cleaning and Protection:

1. Upon completion of gypsum plank decking, remove, debris and sweep surface clean. Leave ready for subsequent work.
2. Protect finished deck from weather and subsequent construction operations.
3. Provide hardboard or plywood temporary protection over decking subject to repetitive impact or wheeled loads.

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**SECTION 05 12 00**  
**STRUCTURAL STEEL FRAMING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies structural steel shown and classified by Section 2, Code of Standard Practice for Steel Buildings and Bridges and Modular Channel Units and accessories.

**1.2 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Painting: Section 09 91 00, PAINTING.
- F. Fireproofing: Section 07 81 00, APPLIED FIREPROOFING.

**1.3 QUALITY ASSURANCE:**

- A. Fabricator and erector shall maintain a program of quality assurance in conformance with Section 8, Code of Standard Practice for Steel Buildings and Bridges. Work shall be fabricated in an AISC certified Category Std fabrication plant.
- B. Before authorizing the commencement of steel erection, the controlling contractor shall ensure that the steel erector is provided with the written notification required by 29 CFR 1926.752. Provide copy of this notification to the Resident Engineer.

**1.4 TOLERANCES:**

Fabrication tolerances for structural steel shall be held within limits established by ASTM A6, by AISC 303, Sections 6 and 7, Code of Standard Practice for Buildings and Bridges.

**1.5 DESIGN:**

- A. Connections: Use details consistent with the details shown on the Drawings, supplementing where necessary. Promptly notify the Resident Engineer of any location where the connection design criteria is not clearly indicated. The design of all connections is subject to the review and acceptance of the Resident Engineer.

**1.6 REGULATORY REQUIREMENTS:**

- A. AISC 360: Specification for Structural Steel Buildings
- B. AISC 303: Code of Standard Practice for Steel Buildings and Bridges.

**1.7 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop and Erection Drawings: Complete
- C. Certificates:

1. Structural steel.
2. Steel for all connections.
3. Welding materials.
4. Shop coat primer paint.

D. Test Reports:

1. Welders' qualifying tests.

**1.8 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Institute of Steel Construction (AISC):
1. AISC 360-10 Specification for Structural Steel Buildings
  3. AISC 303-10 Code of Standard Practice for Steel Buildings and Bridges
- C. American National Standards Institute (ANSI):
- B18.22.1-65(R2008).....Plain Washers
- B18.22M-81(R2000).....Metric Plain Washers
- D. American Society for Testing and Materials (ASTM):
- A6/A6M-11.....Standard Specification for General Requirements  
for Rolled Structural Steel Bars, Plates,  
Shapes, and Sheet Piling
- A36/A36M-08.....Standard Specification for Carbon Structural  
Steel
- A123/A123M-09.....Standard Specification for Zinc (Hot-Dip  
Galvanized) Coatings on Iron and Steel Products
- A242/A242M-04(R2009)....Standard Specification for High-Strength Low-  
Alloy Structural Steel
- A283/A283M-03(R2007)....Standard Specification for Low and Intermediate  
Tensile Strength Carbon Steel Plates
- A307-10.....Standard Specification for Carbon Steel Bolts  
and Studs, 60,000 psi Tensile Strength
- A325-10.....Standard Specification for Structural Bolts,  
Steel, Heat Treated, 120/105 ksi Minimum Tensile  
Strength
- A490-12.....Standard Specification for Heat-Treated Steel  
Structural Bolts 150 ksi Minimum Tensile  
Strength
- A500/A500M-10a.....Standard Specification for Cold Formed Welded  
and Seamless Carbon Steel Structural Tubing in  
Rounds and Shapes

- A501-07.....Standard Specification for Hot-Formed Welded and  
Seamless Carbon Steel Structural Tubing
- A572/A572M-07.....Standard Specification for High-Strength  
Low-Alloy Columbium-Vanadium Structural Steel
- A992/A992M-11.....Standard Specification for Structural Steel  
Shapes
- E. American Welding Society (AWS):  
D1.1/D1.1M-10.....Structural Welding Code-Steel
- F. Research Council on Structural Connections (RCSC) of The Engineering  
Foundation:  
Specification for Structural Joints Using ASTM A325 or A490 Bolts
- G. Military Specifications (Mil. Spec.):  
MIL-P-21035.....Paint, High Zinc Dust Content, Galvanizing,  
Repair
- H. Occupational Safety and Health Administration (OSHA):  
29 CFR Part 1926-2001...Safety Standards for Steel Erection

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS:**

- A. Structural Steel: ASTM A36.
- B. Structural Tubing: ASTM A500, Grade B.
- C. Structural Tubing: ASTM A501.
- D. Steel Pipe: ASTM A53, Grade B.
- E. Bolts, Nuts and Washers:
1. High-strength bolts, including nuts and washers: ASTM A325.
  2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
  3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ANSI Standard B18.22.1.
  4. Hollow section connectors: Type HB-Hollo-Bolt zinc plated steel by Lindapter (or equal).
- F. Modular Channel Units: Unistrut
1. Factory fabricated, channel shaped, cold formed sheet steel shapes, complete with fittings bolts and nuts required for assembly.
  2. Form channel with in-turned pyramid shaped clamping ridges on each side.
  3. Provide case hardened steel nuts with serrated grooves in the top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.
  4. Factory finish channels and parts with oven baked primer when exposed to view. Channels fabricated of ASTM A525, G90 galvanized steel may

have primer omitted in concealed locations. Finish screws and nuts with zinc coating.

5. Fabricate snap-in closure plates to fit and close exposed channel openings of not more than 0.3 mm (0.0125 inch) thick stainless steel.

G. Zinc Coating: ASTM A123.

H. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
- B. Field weld in accordance with AWS.
  1. Design and finish as specified for shop welding.
  2. Use continuous weld unless specified otherwise.

#### **3.2 CONNECTIONS (SHOP AND FIELD):**

- A. Welding: Welding in accordance with AWS D1.1. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
- B. High-Strength Bolts: High-strength bolts tightened to a bolt tension not less than 70% of their minimum tensile strength. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers).

#### **3.3 FABRICATION:**

Fabrication in accordance with Chapter M, AISC 360. .

#### **3.4 SHOP PAINTING:**

- A. General: Shop paint steel with primer in accordance with AISC 303, Section 6.
- B. Shop paint for steel surfaces is specified in Section 09 91 00, PAINTING.
- C. Do not apply paint to following:
  1. Surfaces within 50 mm (2 inches) of joints to be welded in field.
  2. Surfaces which will be encased in concrete.
  3. Surfaces which will receive sprayed on fireproofing.
- D. Structural steel in the interstitial space that does not receive sprayed on fireproofing shall be painted with primer in accordance with general requirement of shop painting.
- E. Zinc Coated (Hot Dip Galvanized) per ASTM A123 (after fabrication):  
Touch-up after erection: Clean and wire brush any abraded and other

spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.

**3.5 ERECTION:**

- A. General: Erection in accordance with AISC 303, Section 7B. Temporary Supports: Temporary support of structural steel frames during erection in accordance with AISC 303, Section 7

**3.6 FIELD PAINTING:**

- A. After erection, touch-up steel surfaces specified to be shop painted. After welding is completed, clean and prime areas not painted due to field welding.
- B. Finish painting of steel surfaces is specified in Section 09 91 00, PAINTING.

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**SECTION 06 10 00**  
**ROUGH CARPENTRY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

Section specifies wood blocking, framing, sheathing, furring, nailers and rough hardware.

**1.2 RELATED WORK:**

- A. Milled woodwork: Section 06 20 00, FINISH CARPENTRY.
- B. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.

**1.3 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings showing framing connection details, fasteners, connections and dimensions.

**1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:**

- A. Protect lumber and other products from dampness both during and after delivery at site.
- B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.
- C. Stack plywood and other board products so as to prevent warping.
- D. Locate stacks on well drained areas, supported at least 150 mm (6 inches) above grade and cover with well ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

**1.5 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Society of Mechanical Engineers (ASME):
  - B18.2.1-96(R2005).....Square and Hex Bolts and Screws
  - B18.2.2-87.....Square and Hex Nuts
  - B18.6.1-97.....Wood Screws
  - B18.6.4-98(R2005).....Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws
- C. American Plywood Association (APA):
  - E30-07.....Engineered Wood Construction Guide
- D. American Society for Testing And Materials (ASTM):
  - A47-99(R2009).....Ferritic Malleable Iron Castings

- A48-03(R2008).....Gray Iron Castings
- A653/A653M-10.....Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process
- C954-10.....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch (2.24 mm) to 0.112-inch (2.84 mm) in thickness
- C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs
- D143-09.....Small Clear Specimens of Timber, Method of Testing
- F844-07.....Washers, Steel, Plain (Flat) Unhardened for General Use
- E. Federal Specifications (Fed. Spec.):
- MM-L-736C.....Lumber; Hardwood
- F Commercial Item Description (CID):
- A-A-55615.....Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)
- G. Military Specification (Mil. Spec.):
- MIL-L-19140E.....Lumber and Plywood, Fire-Retardant Treated
- H. U.S. Department of Commerce Product Standard (PS)
- PS 1-95.....Construction and Industrial Plywood
- PS 20-05.....American Softwood Lumber Standard

## **PART 2 - PRODUCTS**

### **2.1 LUMBER:**

- A. Lumber Other Than Structural:
1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
  2. Furring, blocking, nailers and similar items 100 mm (4 inches) and narrower Standard Grade; and, members 150 mm (6 inches) and wider, Number 2 Grade.
- B. Sizes:
1. Conforming to Prod. Std., PS20.
  2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.

C. Moisture Content:

1. At time of delivery and maintained at the site.
2. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.

D. Fire Retardant Treatment:

1. Mil Spec. MIL-L-19140 with piece of treated material bearing identification of testing agency and showing performance rating.
2. Treatment and performance inspection, by an independent and qualified testing agency that establishes performance ratings.

E. Preservative Treatment:

2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including framing of open roofed structures; sills, sole plates, furring, and sleepers that are less than 600 mm (24 inches) from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members used in connection with roofing and flashing materials.
3. Treat other members specified as preservative treated (PT).
4. Preservative treat by the pressure method complying with ASTM D1760, except any process involving the use of Chromated Copper arsenate (CCA) for pressure treating wood is not permitted.

## **2.2 PLYWOOD**

- A. Comply with Prod. Std., PS 1.
- B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.
- C. Sheathing:
  1. APA rated Exposure 1 or Exterior; panel grade CD or better.

## **2.3 ROUGH HARDWARE AND ADHESIVES:**

- A. Miscellaneous Bolts: Expansion Bolts: C1D, A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Use 13 mm (1/2 inch) bolt unless shown otherwise.
- B. Washers
  1. ASTM F844.
  2. Use zinc or cadmium coated steel or cast iron for washers exposed to weather.
- C. Screws:
  1. Wood to Wood: ANSI B18.6.1 or ASTM C1002.



2. Wood to Steel: ASTM C954, or ASTM C1002.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS:**

- A. Conform to applicable requirements of the following:
  4. APA for installation of plywood.
- B. Fasteners:
  2. Bolts:
    - a. Fit bolt heads and nuts bearing on wood with washers.
    - b. Countersink bolt heads flush with the surface of nailers.
    - c. Embed in concrete and solid masonry or use expansion bolts.  
Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
    - d. Use toggle bolts to hollow masonry or sheet metal.
    - e. Use bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 600 mm (24 inch) intervals between end bolts. Use clips to beam flanges.
  3. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.
    - a. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.
    - b. ASTM C 954 for steel over 0.84 mm (0.033 inch) thick.
  4. Power actuated drive pins may be used where practical to anchor to solid masonry, concrete, or steel.
  5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Use metal plugs, inserts or similar fastening.
  6. Screws to Join Wood:
    - a. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.
    - b. Spaced same as nails.
- C. Rough Bucks:
  1. Install rough wood bucks at opening in masonry or concrete where wood frames or trim occur.
  2. Cut rough bucks from 50 mm (2 inch) thick stock, of same width as partitions in which they occur and of width shown in exterior walls.
  3. Extend bucks full height of openings and across head of openings; fasten securely with anchors specified.

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**SECTION 06 20 00**  
**FINISH CARPENTRY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies exterior and interior millwork.
- B. Items specified.
  - Counter or Work Tops

**1.2 RELATED WORK**

- A. Fabricated Metal brackets, bench supports and countertop legs: Section 05 50 00, METAL FABRICATIONS.
- B. Framing, furring and blocking: Section 06 10 00, ROUGH CARPENTRY.
- C. Electrical light fixtures and duplex outlets: Division 26, ELECTRICAL.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
  - 1. Millwork items - Half full size scale for sections and details 1:50 (1/4-inch) for elevations and plans.
  - 2. Show construction and installation.
- C. Samples:
  - Plastic laminate finished plywood or particleboard, 150 mm by 300 mm (six by twelve inches).
- D. Certificates:
  - 1. Indicating retardant treatment of materials meet the requirements specified.
  - 2. Indicating moisture content of materials meet the requirements specified.
- E. List of acceptable sealers for fire retardant and preservative treated materials.
- F. Manufacturer's literature and data:
  - 1. Finish hardware
  - 2. Electrical components

**1.4 DELIVERY, STORAGE AND HANDLING**

- A. Protect lumber and millwork from dampness, maintaining moisture content specified both during and after delivery at site.
- B. Store finishing lumber and millwork in weathertight well ventilated structures or in space in existing buildings designated by Resident

Engineer. Store at a minimum temperature of 21<sup>0</sup>C (70<sup>0</sup>F) for not less than 10 days before installation.

- C. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Hardboard Association (AHA):  
A135.4-04.....Basic Hardboard
- C. Builders Hardware Manufacturers Association (BHMA):  
A156.9-03.....Cabinet Hardware  
A156.11-10.....Cabinet Locks  
A156.16-08.....Auxiliary Hardware
- D. Hardwood Plywood and Veneer Association (HPVA):  
HP1-09.....Hardwood and Decorative Plywood
- E. Architectural Woodwork Institute (AWI):  
AWI-09.....Architectural Woodwork Quality Standards and  
Quality Certification Program
- F. National Electrical Manufacturers Association (NEMA):  
LD 3-05.....High-Pressure Decorative Laminates
- G. U.S. Department of Commerce, Product Standard (PS):  
PS20-10.....American Softwood Lumber Standard
- H. Military Specification (Mil. Spec):  
MIL-L-19140E.....Lumber and Plywood, Fire-Retardant Treated
- I. Federal Specifications (Fed. Spec.):  
A-A-1922A.....Shield Expansion  
A-A-1936.....Contact Adhesive  
FF-N-836D.....Nut, Square, Hexagon Cap, Slotted, Castle  
FF-S-111D(1).....Screw, Wood  
MM-L-736(C).....Lumber, Hardwood

#### **PART 2 - PRODUCTS**

##### **2.1 BIO-BASED MATERIAL:**

Bio-based Materials: For products designated by the USDA's Bio-Preferred program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specification section. For more information regarding the product categories covered by the Bio-Preferred program, visit <http://www.bio-preferred.gov>

## **2.2 LUMBER**

### **A. Grading and Marking:**

1. Lumber shall bear the grade mark, stamp, or other identifying marks indicating grades of material.
2. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
3. The inspection agency for lumber shall be approved by the Board of Review, American Lumber Standards Committee, to grade species used.

### **B. Sizes:**

1. Lumber Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which product is produced.
2. Millwork, standing and running trim, and rails: Actual size as shown or specified.

### **C. Hardwood: MM-L-736, species as specified for each item.**

### **D. Softwood: PS-20, exposed to view appearance grades:**

1. Use C select or D select, vertical grain for transparent finish including stain transparent finish.
2. Use Prime for painted or opaque finish.

### **E. Use edge grain Wood members exposed to weather.**

## **2.3 PLYWOOD**

### **A. Softwood Plywood:**

1. Prod. Std.
2. Grading and Marking:
  - a. Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood.
  - b. The mark shall identify the plywood by species group or identification index, and shall show glue type, grade, and compliance with PS1.
3. Plywood, 13 mm (1/2 inch) and thicker; not less than five ply construction, except 32 mm (1-1/4 inch) thick plywood not less than seven ply.
4. Plastic Laminate Plywood Cores:
  - a. Exterior Type, and species group.
  - b. Veneer Grade: A-C.

5. Shelving Plywood:

- a. Interior Type, any species group.
- b. Veneer Grade: A-B or B-C.

6. Other: As specified for item.

B. Hardwood Plywood:

- 1. HPVA: HP.1
- 2. Species of face veneer shall be as shown or as specified in connection with each particular item.
- 3. Inside of Building:
  - a. Use Type II (interior) A grade veneer for transparent finish.
  - b. Use Type II (interior) Sound Grade veneer for paint finish.
- 4. Use plain sliced red oak unless specified otherwise.

**2.4 PARTICLEBOARD**

A. NPA A208.1

B. Plastic Laminate Particleboard Cores:

- 1. Use Type 1, Grade 1-M-3, or Type 2, Grade 2-M-2, unless otherwise specified.
- 2. Use Type 2, Grade 2-M-2, exterior bond, for tops with sinks.

C. General Use: Type 1, Grade 1-M-3 or Type 2, Grade 2-M-2.

**2.5 PLASTIC LAMINATE**

A. NEMA LD-3.

B. Exposed decorative surfaces including countertops, both sides of cabinet doors, and for items having plastic laminate finish. General Purpose, Type HGL.

C. Cabinet Interiors including Shelving: Both of following options to comply with NEMA, CLS as a minimum.

- 1. Plastic laminate clad plywood or particle board.
- 2. Resin impregnated decorative paper thermally fused to particle board.

D. Backing sheet on bottom of plastic laminate covered wood tops: Backer, Type HGP.

E. Post Forming Fabrication, Decorative Surfaces: Post forming, Type HGP.

**2.6 BUILDING BOARD (HARDBOARD)**

A. ANSI/AHA A135.4, 6 mm (1/4 inch) thick unless specified otherwise.

B. Perforated hardboard (Pegboard): Type 1, Tempered perforated 6 mm (1/4 inch) diameter holes, on 25 mm (1 inch) centers each way, smooth surface one side.

C. Wall paneling at gas chain rack: Type 1, tempered, Fire Retardant treated, smooth surface on side.

## **2.7 ADHESIVE**

- A. For Plastic Laminate: Fed. Spec. A-A-1936.
- B. For Interior Millwork: Unextended urea resin, unextended melamine resin, phenol resin, or resorcinol resin.
- C. For Exterior Millwork: Unextended melamine resin, phenol resin, or resorcinol resin.

## **2.8 STAINLESS STEEL**

ASTM A167, Type 302 or 304.

## **2.9 ALUMINUM CAST**

ASTM B26

## **2.10 ALUMINUM EXTRUDED**

ASTM B221

## **2.11 HARDWARE**

### **A. Finish Hardware**

- 1. Cabinet Hardware: ANSI A156.9.
  - a. Door/Drawer Pulls: B02011. Door in seismic zones: B03182.
  - b. Drawer Slides: B05051 for drawers over 150 mm (6 inches) deep, B05052 for drawers 75 mm to 150 mm 3 to 6 inches) deep, and B05053 for drawers less than 75 mm (3 inches) deep.
  - c. Sliding Door Tracks: B07063.
  - d. Adjustable Shelf Standards: B4061 with shelf rest B04083.
  - e. Concealed Hinges: B1601, minimum 110 degree opening.
  - f. Butt Hinges: B01361, for flush doors, B01381 for inset lipped doors, and B01521 for overlay doors.
  - g. Cabinet Door Catch: B0371 or B03172.
  - h. Vertical Slotted Shelf Standard: B04103 with shelf brackets B04113, sized for shelf depth.
- 2. Cabinet Locks: ANSI A156.11.
  - a. Drawers and Hinged Door: E07262.
  - b. Sliding Door: E07162.
- 3. Auxiliary Hardware: ANSI A156.16.
  - a. Shelf Bracket: B04041, japanned or enameled finish.
  - b. Combination Garment rod and Shelf Support: B04051 japanned or enamel finish.
  - c. Closet Bar: L03131 chrome finish of required length.
  - d. Handrail Brackets: L03081 or L03101.
    - 1) Cast Aluminum, satin polished finish.
    - 2) Cast Malleable Iron, japanned or enamel finish.

4. Steel Channel Frame and Leg supports for Counter top. Fabricated under Section 05 50 00, METAL FABRICATIONS.
5. Pipe Bench Supports:
  - a. Pipe: ASTM A53.
6. Fabricated Wall Bench Supports:
  - a. Steel Angles: ASTM A36 steel with chrome finish, or ASTM A167, stainless steel with countersunk wood screws, holes at 64 mm (2-1/2 inches) on center on horizontal member.
  - b. Use 38 mm by 38 mm by 5 mm (1-1/2 by 1-1/2 by 3/16 inch) angle thick drilled for screw and bolt holes unless shown otherwise. Drill 6 mm (1/4 inch) holes for anchors on vertical member, not more than 200 mm (8 inches) on center between ends or corners.
  - c. Stainless steel bars brackets: ASTM A167, fabricated to shapes shown, Number 4 finish. Use 50 mm by 5 mm (2 inch by 3/16 inch) bars unless shown otherwise. Drill for anchors and screws. Drill countersunk wood screw holes at 64 mm (2-1/2 inches) on center on horizontal members and not less than two 13 mm (1/4 inch) hole for anchors on vertical member.
7. Thru-Wall Counter Brackets:
  - a. Steel angles drilled for fasteners on 100 mm (4 inches) centers.
  - b. Baked enamel prime coat finish.
8. Folding Shelf Bracket:
  - a. Steel Shelf bracket, approximately 400 mm by 400 mm (16 by 16 inches), folding type with baked gray enamel finish or chrome plated finish.
  - b. Bracket legs shall be approximately 28 mm (1-1/8 inches) wide.
  - c. Distance from center line of hinge pin to back of vertical leg shall be 44 mm (1-3/4 inches) or provide for wood spacer if hinge line is at joint of vertical and horizontal leg.
  - d. Distance from face to face of bracket when closed shall be 50 mm (2 inches).
  - e. Brackets shall automatically lock when counter is raised parallel to floor and shall unlock manually.
  - f. Each bracket shall support not less than 68 Kg (150 pounds) evenly distributed.
9. Edge Strips Moldings:
  - a. Driven type "T" shape with serrated retaining stem; vinyl plastic to match plastic laminate color, stainless steel, or 3 mm (1/8 inch) thick extruded aluminum.
  - b. Stainless steel or extruded aluminum channels.

- c. Stainless steel, number 4 finish; aluminum, mechanical applied medium satin finish, clear anodized 0.1 mm (0.4 mils) thick.
- 10. Rubber or Vinyl molding
  - a. Rubber or vinyl standard stock and in longest lengths practicable.
  - b. Design for closures at joints with walls and adhesive anchorage.
  - c. Adhesive as recommended by molding manufacturer.
- 11. Primers: Manufacturer's standard primer for steel providing baked enamel finish.

## **2.12 MOISTURE CONTENT**

- A. Moisture content of lumber and millwork at time of delivery to site.
  - 1. Interior finish lumber, trim, and millwork 32 mm (1-1/4 inches) or less in nominal thickness: 12 percent on 85 percent of the pieces and 15 percent on the remainder.
  - 2. Exterior treated or untreated finish lumber and trim 100 mm (4 inches) or less in nominal thickness: 15 percent.
  - 3. Moisture content of other materials shall be in accordance with the standards under which the products are produced.

## **2.13 FABRICATION**

- A. General:
  - 1. Except as otherwise specified, use AWI Custom Grade for architectural woodwork and interior millwork.
  - 2. Finish woodwork shall be free from pitch pockets.
  - 3. Except where special profiles are shown, trim shall be standard stock molding and members of the same species.
  - 4. Plywood shall be not less than 13 mm (1/2 inch), unless otherwise shown or specified.
  - 5. Edges of members in contact with concrete or masonry shall have a square corner caulking rebate.
  - 6. Fabricate members less than 4 m (14 feet) in length from one piece of lumber, back channeled and molded as shown.
  - 7. Interior trim and items of millwork to be painted may be fabricated from jointed, built-up, or laminated members, unless otherwise shown on drawings or specified.
  - 8. Plastic Laminate Work:
    - a. Factory glued to either a plywood or a particle board core, thickness as shown or specified.
    - b. Cover exposed edges with plastic laminate, except where aluminum, stainless steel, or plastic molded edge strips are shown or



specified. Use plastic molded edge strips on 19 mm (3/4-inch) molded thick or thinner core material.

c. Provide plastic backing sheet on underside of countertops, vanity tops, thru-wall counter including back splashes and end splashes of countertops.

d. Use backing sheet on concealed large panel surface when decorative face does not occur.

B. Mounting Strips, Shelves and Rods:

1. Cut mounting strips from 25 mm by 100 mm (1 by 4 inches) softwood stock, with exposed edge slightly rounded.

2. Cut wood shelf from softwood 1 inch stock, of width shown, exposed edge slightly rounded. Option: Use 19 mm (3/4 inch) thick plywood with 19 mm (3/4 inch) softwood edge nosing on exposed edge, slightly rounded.

3. Plastic laminate covered, 19 mm (3/4 inch) thick plywood or particle board core with edges and ends having plastic molded edge strips. Size, finish and number as shown.

4. Rod or Closet Bar: L03131. Combination Garment and Shelf Support, intermediate support for closet bar: B04051 for rods over 1800 mm (6 feet) long.

C. Pegboard:

1. Perforated hardboard sheet size as shown.

2. Spacing strip: 13 mm by 13 mm (1/2 by 1/2 inch); glued to hardboard sheet.

a. Locate at perimeter of sheet edge.

b. Locate material intermediate spacing strips at 800 mm (32 inches) o.c.

3. Use 19 mm (3/4 inch) one quarter round edge trim to cover exposed edge and finish flush with hardboard surface. Glue to spacing strip and hard board.

D. Thru-Wall Counter or Pass Thru Counter.

1. Fabricate counter as shown. Return hardwood edge to metal frame at ends. Fabricate to join other counters where shown.

2. Cut to fit metal frame profile.

3. Fabricate to receive sliding pass window track when shown; specified in Section 08 56 19, PASS WINDOWS.

4. Use angle and fabricated shelf bracket supports.

E. Wall Paneling:

1. Fire Retardant Treated
2. Hardwood plywood
  - a. Flush ungrooved.
  - b. Thickness: 19 mm (3/4 inch) unless shown otherwise.
  - c. Prefinished, type of finish is specified in drawings.
  - d. Use full height panels where possible without end joints.
3. Solid hardwood.
  - a. Species as specified, number one common grade.
  - c. Thickness: Not less than 19 mm (3/4 inch).
  - d. Random Lengths not less than 600 mm (24 inches), 57 mm (2-1/4 inches) wide.
4. Trim and base:
  - a. As indicated.
5. Use nominal one by 100 mm (4 inches) softwood furring strips.

F. Counter or Work Tops:

1. Fabrication with plastic laminate over 32 mm (1-1/4 inch) thick core unless shown otherwise.
  - a. Use decorative laminate for exposed edges of tops 38 mm (1-1/2 inches) wide and on back splash and end splash. Use plastic or metal edges for top edges less than 38 mm (1-1/2 inches) wide.
  - b. Assemble back splash and end splash to counter top.
  - c. Use one piece counters for straight runs.
  - d. Miter corners for field joints with overlapping blocking on underside of joint.

**PART 3 - EXECUTION**

**3.1 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain work areas and storage areas to a minimum temperature of 21°C (70°F) for not less than 10 days before and during installation of interior millwork.
- B. Do not install finish lumber or millwork in any room or space where wet process systems such as concrete, masonry, or plaster work is not complete and dry.

**3.2 INSTALLATION**

- A. General:
  1. Millwork receiving transparent finish shall be primed and back-painted on concealed surfaces. Set no millwork until primed and back-painted.
  2. Secure trim with fine finishing nails, screws, or glue as required.

3. Set nails for putty stopping. Use washers under bolt heads where no other bearing plate occurs.
4. Seal cut edges of preservative and fire retardant treated wood materials with a certified acceptable sealer.
5. Coordinate with plumbing and electrical work for installation of fixtures and service connections in millwork items.
6. Plumb and level items unless shown otherwise.
7. Nail finish at each blocking, lookout, or other nailer and intermediate points; toggle or expansion bolt in place where nails are not suitable.

B. Pegboard or Perforated Hardboard:

1. Install board with chromium plated steel round-head toggle bolts or other fasteners capable of supporting board when loaded at 122 kg/m<sup>2</sup> (25 psf) of board.
2. Install board with spacers to allow hooks and accessories to be inserted and removed.
3. Install 6 mm (1/4 inch) round trim at perimeter to finish flush with face of board and close space between wall and hardboard.

C. Wall Paneling:

1. Solid hardwood boards
  - a. Install 25 by 75 mm (1 by 3 inch) furring strips on 400 mm (16 inch) centers horizontally between top and bottom strips. Secure to each stud with two screws.
  - b. Install paneling laid vertically with end joints staggered between adjacent boards.
  - c. Tightly butt joints and blind nail each board at each furring strip.
2. Install edge trim and base as shown, use solid wood members of same species as wall paneling.

D. Shelves:

1. Install mounting strip at back wall and end wall for shelves in closets where shown secured with toggle bolts at each end and not over 600 mm (24 inch) centers between ends.
  - a. Nail Shelf to mounting strip at ends and to back wall strip at not over 900 mm (36 inches) on center.
  - b. Install metal bracket, ANSI A156.16, B04041, not over 1200 mm (4 feet) centers when shelves exceed 1800 mm (6 feet) in length.
  - c. Install metal bracket, ANSI A156.16, B04051, not over 1200 mm (4 feet) on centers where shelf length exceeds 1800 mm (6 feet) in

length with metal rods, clothes hanger bars ANSI A156.16, L03131,  
of required length, full length of shelf.

2. Install vertical slotted shelf standards, ANSI A156.9, B04103 to  
studs with toggle bolts through each fastener opening. Double slotted  
shelf standards may be used where adjacent shelves terminate.
  - a. Install brackets ANSI A156.9, B04113, providing supports for shelf  
not over 900 mm (36 inches) on center and within 13 mm (1/2 inch)  
of shelf end unless shown otherwise.
  - b. Install shelves on brackets so front edge is restrained by  
bracket.

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**SECTION 07 21 13  
THERMAL INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies thermal and acoustical insulation for buildings.
- B. Acoustical insulation is identified by thickness and words "Acoustical Insulation".

**1.2 RELATED WORK**

- A. Safing insulation: Section 07 84 00, FIRESTOPPING.

**1.3 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Insulation, each type used
  - 2. Adhesive, each type used.
  - 3. Tape
- C. Certificates: Stating the type, thickness and "R" value (thermal resistance) of the insulation to be installed.

**1.4 STORAGE AND HANDLING:**

- A. Store insulation materials in weathertight enclosure.
- B. Protect insulation from damage from handling, weather and construction operations before, during, and after installation.

**1.5 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - C552-07.....Cellular Glass Thermal Insulation.
  - C553-08.....Mineral Fiber Blanket Thermal Insulation for  
Commercial and Industrial Applications
  - C578-10.....Rigid, Cellular Polystyrene Thermal Insulation
  - C591-09.....Unfaced Preformed Rigid Cellular  
Polyisocyanurate Thermal Insulation
  - C612-10.....Mineral Fiber Block and Board Thermal  
Insulation
  - C728-05 (R2010).....Perlite Thermal Insulation Board

C954-10.....Steel Drill Screws for the Application of  
Gypsum Panel Products or Metal Plaster Base to  
Steel Studs From 0.033 (0.84 mm) inch to 0.112  
inch (2.84 mm) in thickness  
C1002-07.....Steel Self-Piercing Tapping Screws for the  
Application of Gypsum Panel Products or Metal  
Plaster Bases to Wood Studs or Steel Studs  
E84-10.....Surface Burning Characteristics of Building  
Materials  
F1667-11.....Driven Fasteners: Nails, Spikes and Staples.

## **PART 2 - PRODUCTS**

### **2.1 INSULATION - GENERAL:**

- A. Where thermal resistance ("R" value) is specified or shown for insulation, the thickness shown on the drawings is nominal. Use only insulation with actual thickness that is not less than that required to provide the thermal resistance specified.
- B. Where "R" value is not specified for insulation, use the thickness shown on the drawings.
- C. Where more than one type of insulation is specified, the type of insulation for each use is optional, except use only one type of insulation in any particular area.
- D. Insulation Products shall comply with following minimum content standards for recovered materials:

Material Type	Percent by Weight
Perlite composite board	23 percent post consumer recovered paper
Polyisocyanurate/polyurethane	
Rigid foam	9 percent recovered material
Foam-in-place	5 percent recovered material
Glass fiber reinforced	6 percent recovered material
Phenolic rigid foam	5 percent recovered material
Rock wool material	75 percent recovered material

The minimum-content standards are based on the weight (not the volume) of the material in the insulating core only.

## **2.2 ACOUSTICAL INSULATION:**

- A. Mineral Fiber boards: ASTM C553, Type II, flexible, or Type III, semirigid (4.5 pound nominal density).
- B. Mineral Fiber Batt or Blankets: ASTM C665. Maximum flame spread of 25 and smoke development of 450 when tested in accordance with ASTM E84.
- C. Thickness as shown; of widths and lengths to fit tight against framing.

## **2.3 FASTENERS:**

- A. Staples or Nails: ASTM F1667, zinc-coated, size and type best suited for purpose.
- B. Screws: ASTM C954 or C1002, size and length best suited for purpose with washer not less than 50 mm (two inches) in diameter.
- C. Impaling Pins: Steel pins with head not less than 50 mm (two inches) in diameter with adhesive for anchorage to substrate. Provide impaling pins of length to extend beyond insulation and retain cap washer when washer is placed on the pin.

## **2.4 ADHESIVE:**

- A. As recommended by the manufacturer of the insulation.
- B. Asphalt: ASTM D312, Type III or IV.
- C. Mortar: ASTM C270, Type 0.

## **2.5 TAPE:**

- A. Pressure sensitive adhesive on one face.
- B. Perm rating of not more than 0.50.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION - GENERAL**

- A. Install insulation with the vapor barrier facing the heated side, unless specified otherwise.
- B. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.
- C. Install batt or blanket insulation with tight joints and filling framing void completely. Seal cuts, tears, and unlapped joints with tape.
- D. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

### **3.2 ACOUSTICAL INSULATION:**

- A. Fasten blanket insulation between metal studs and wall furring with continuous pressure sensitive tape along edges or adhesive.

- B. Pack insulation around door frames and windows and in cracks, expansion joints, control joints, door soffits and other voids. Pack behind outlets, around pipes, ducts, and services encased in wall or partition. Hold insulation in place with pressure sensitive tape or adhesive.
- C. Do not compress insulation below required thickness except where embedded items prevent required thickness.
- D. Where acoustical insulation is installed above suspended ceilings install blanket at right angles to the main runners or framing. Extend insulation over wall insulation systems not extending to structure above.
- E. Where semi-rigid insulation is used which is not full thickness of cavity, adhere to one side of cavity maintaining continuity of insulation and covering penetrations or embedments in insulation.
- F. Where sound deadening board is shown, secure with adhesive to masonry or concrete walls. Secure sufficiently in place until subsequent cover is installed. Seal all cracks with caulking.

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**SECTION 07 81 00  
APPLIED FIREPROOFING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies mineral fiber and cementitious coverings to provide fire resistance to interior structural steel members shown.

**1.2 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Manufacturer's complete and detailed application instructions and specifications.
  - 2. Manufacturer's repair and patching instructions.
- C. Certificates:
  - 1. Certificate from testing laboratory attesting fireproofing material and application method meet the specified fire ratings.
    - a. List thickness and density of material required to meet fire ratings.
    - b. Accompanied by complete test report and test record.
  - 2. Manufacturer's certificate indicating sprayed-on fireproofing material supplied under the Contract is same within manufacturing tolerance as fireproofing material tested.
- D. Miscellaneous:
  - 1. Manufacturer's written approval of surfaces to receive sprayed-on fireproofing.
  - 2. Manufacturer's written approval of completed installation.
  - 3. Manufacturer's written approval of the applicators of fireproofing material.

**1.3 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Deliver to job-site in sealed containers marked and labeled to show manufacturer's name and brand and certification of compliance with the specified requirements.
- B. Remove damaged containers from the site.
- C. Store the materials off the ground, under cover, away from damp surfaces.
- D. Keep dry until ready for use.

- E. Remove materials that have been exposed to water before installation from the site.

#### **1.4 QUALITY CONTROL**

- A. Test for fire endurance in accordance with ASTM E119, for fire rating specified, in a nationally recognized laboratory.
- B. Manufacturer's inspection and approval of surfaces to receive fireproofing as specified under paragraph Examination.
- C. Manufacturer's approval of fireproofing applications.
- D. Manufacturer's approval of completed installation.
- E. Manufacturer's representative shall observe and advise at the commencement of application, and shall visit the site as required thereafter for the purpose of ascertaining proper application.
- F. Pre-Application Test Area.
  - 1. Install in location selected by the Resident Engineer, for approval by the representative of the fireproofing material manufacturer and by the Government.
  - 2. Perform Bond test on painted steel in accordance with ASTM E736.
  - 3. Do not proceed in other areas until installation of test area has been completed and approved.
  - 4. Keep approved installation area open for observation as criteria for sprayed-on fireproofing.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - C841-03(R2008).....Installation of Interior Lathing and Furring
  - C847-10.....Metal Lath
  - E84-10.....Surface Burning Characteristics of Building Materials
  - E119-10.....Fire Tests of Building Construction and Materials
  - E605-93(R2006).....Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members
  - E736-00(R2006).....Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

- E759-92 (R2005) .....The Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
- E760-92 (R2005) .....Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members
- E761-92 (R2005) .....Compressive Strength of Fire-Resistive Material Applied to Structural Members
- E859-93 (R2006) .....Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members
- E937-93 (R2005) .....Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members
- E1042-02 (R2008) .....Acoustically, Absorptive Materials Applied by Trowel or Spray.
- G21-09.....Determining Resistance of Synthetic Polymeric Materials to Fungi
- C. Underwriters Laboratories, Inc. (UL):  
Fire Resistance Directory...Latest Edition including Supplements
- D. Warnock Hersey (WH):  
Certification Listings..Latest Edition
- E. Factory Mutual System (FM):  
Approval Guide.....Latest Edition including Supplements

## **PART 2 - PRODUCTS**

### **2.1 SPRAYED-ON FIREPROOFING**

- A. ASTM E1042, Class (a), Category A.
1. Type I, factory mixed cementitious materials with approved aggregate.
  2. Type II, factory mixed mineral fiber with integral inorganic binders minimum 240 kg/m<sup>3</sup> (15 lb/ft<sup>3</sup>) density per ASTM E605 test unless specified otherwise. Use in areas that are completely encased.
- B. Materials containing asbestos are not permitted.
- C. Fireproofing characteristics when applied in the thickness and density required to achieve the fire-rating specified.

	Characteristic	Test	Results
1.	Deflection	ASTM E759	No cracking, spalling, or delamination when backing to which it is applied has a deflection up to 1/120 in 3m (10 ft.)
2.	Corrosion-Resistance	ASTM E937	No promotion of corrosion of steel.
3.	Bond Impact	ASTM E760	No cracking, spalling, or delamination.
4.	Cohesion/Adhesion (Bond Strength)	ASTM E736	Minimum cohesive/adhesive strength of 9.57 kPa (200 lbf/ft <sup>2</sup> ) for protected areas. 19.15 kPa (400 lbf/ft <sup>2</sup> ) for exposed areas.
5.	Air Erosion	ASTM E859	Maximum gain weight of the collecting filter 0.27gm/m <sup>2</sup> (0.025 gm/ft <sup>2</sup> ).
6.	Compressive Strength	ASTM E761	Minimum compressive strength 48 kPa (1000psf).
7.	Surface Burning Characteristics with adhesive and sealer to be used	ASTM E84	Flame spread 25 or less smoke developed 50 or less
8.	Fungi Resistance	ASTM G21	Resistance to mold growth when inoculated with aspergillus niger (28 days for general application)

## 2.2 ADHESIVE

- A. Bonding adhesive for Type II (fibrous) materials as recommended and supplied by the fireproofing material manufacturer.
- B. Adhesive may be an integral part of the material or applied separately to surface receiving fireproofing material.

## 2.3 SEALER

- A. Sealer for Type II (fibrous) material as recommended and supplied by the fireproofing material manufacturer.
- B. Surface burning characteristics as specified for fireproofing material.
- C. Fungus resistant.
- D. Sealer may be an integral part of the material or applied separately to the exposed surface. When applied separately use contrasting color pigmented sealer, white preferred.

## **2.4 WATER**

- A. Clean, fresh, and free from organic and mineral impurities.
- B. pH of 6.9 to 7.1.

## **2.5 MECHANICAL BOND MATERIAL**

- A. Expanded Metal Lath: ASTM C847, minimum weight of 0.92 kg/m<sup>2</sup> (1.7 pounds per square yard).
- B. Fasteners: ASTM C841.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify surfaces to receive fireproofing are clean and free of dust, soot, oil, grease, water soluble materials or any foreign substance which would prevent adhesion of the fireproofing material.
- B. Verify hangers, inserts and clips are installed before the application of fireproofing material.
- C. Verify ductwork, piping, and other obstructing material and equipment is not installed that will interfere with fireproofing installation.
- D. Verify concrete work on steel decking and concrete encased steel is completed.
- E. Verify temperature and enclosure conditions are required by fireproofing material manufacturer.

### **3.2 APPLICATION**

- A. Do not start application until written approval has been obtained from manufacturer of fireproofing materials that surfaces have been inspected by the manufacturer or his representative, and are suitable to receive sprayed-on fireproofing.
- B. Coordinate application of fireproofing material with other trades.
- C. Application of Metal Lath:
  - 1. Apply to beam and columns having painted surfaces which fail ASTM E736 Bond Test requirements in pre-application test area.
  - 2. Apply to beam flanges 300 mm (12-inches) or more in width.
  - 3. Apply to column flanges 400 mm (16-inches) or more in width.
  - 4. Apply to beam or column web 400 mm (16-inches) or more in depth.
  - 5. Tack weld or mechanically fasten on maximum of 300 mm (12-inch) center.
  - 6. Lap and tie lath member in accordance with ASTM C841.
- D. Mix and apply in accordance with manufacturer's instructions.
  - 1. Mechanically control material and water ratios.

2. Apply adhesive and sealer, when not an integral part of the materials, in accordance with the manufacturer's instructions.
3. Apply to density and thickness indicated in UL Fire Resistance Directory, FM Approval Guide, or WH Certification Listings unless specified otherwise. Test in accordance with ASTM E119.
4. Minimum applied dry density per cubic meter (cubic foot) for the underside of the walk on deck (interstitial) hung purl in or beam and steel deck, columns in interstitial spaces and mechanical equipment rooms shall be as follows:
  - a. Type I - 240 kg/m<sup>3</sup> (15 lb/ft<sup>3</sup>).
  - b. Type II - 350 kg/m<sup>3</sup> (22 lb/ft<sup>3</sup>).
- E. Application shall be completed in one area, inspected and approved by Resident Engineer before removal of application equipment and proceeding with further work.

### **3.3 FIELD TESTS**

- A. Tests of applied material will be performed by VA retained Testing Laboratory. See Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Resident Engineer will select area to be tested in specific bays on each floor using a geometric grid pattern.
- C. Test for thickness and density in accordance with ASTM E605. Areas showing thickness less than that required as a result of fire endurance test will be rejected.
- D. Areas showing less than required fireproofing characteristics will be rejected on the following field tests.
  1. Test for cohesion/adhesion: ASTM E736.
  2. Test for bond impact strength: ASTM E760.

### **3.3 PATCHING AND REPAIRING**

- A. Inspect after mechanical, electrical and other trades have completed work in contact with fireproofing material, but before sprayed material is covered by subsequent construction.
- B. Perform corrective measures in accordance with fireproofing material Manufacturer's recommendations.
  1. Respray areas requiring additional fireproofing material to provide the required thickness, and replace dislodged or removed material.
  2. Spray material for patching by machine directly on point to be patched, or into a container and then hand apply.
  3. Hand mixing of material is not permitted.

C. Repair:

1. Respray all test and rejected areas.
2. Patch fireproofing material which is removed or disturbed after approval.

D. Perform final inspection of sprayed areas after patching and repair.

**3.5 SCHEDULE**

A. Apply fireproofing material in interior structural steel members // and on underside of interior steel floor and roof decks //, except on following surfaces:

1. Structural steel and underside of steel decks in elevator or dumbwaiter machine rooms.
2. Steel members in elevator hoist ways.
3. Areas used as air handling plenums.
4. Steel to be encased in concrete or designated to receive other type of fireproofing.

B. Type I:

1. One hour fire rating.
2. Two hour fire rating.
3. Three hour fire rating.

C. Type II:

1. One hour fire rating.
2. Two hour fire rating.

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**SECTION 07 84 00**  
**FIRESTOPPING**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.
- B. Closure of openings in walls against penetration of gases or smoke in smoke partitions.

**1.2 RELATED WORK**

- A. Sealants and application: Section 07 92 00, JOINT SEALANTS.
- B. Fire and smoke damper assemblies in ductwork: Section 23 31 00, HVAC DUCTS AND CASINGS Section 23 37 00, AIR OUTLETS AND INLETS.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.
- C. List of FM, UL, or WH classification number of systems installed.
- D. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

**1.4 DELIVERY AND STORAGE**

- A. Deliver materials in their original unopened containers with manufacturer's name and product identification.
- B. Store in a location providing protection from damage and exposure to the elements.

**1.5 WARRANTY**

- A. See Solicitation Documents for Warranty requirements.

**1.6 QUALITY ASSURANCE**

FM, UL, or WH or other approved laboratory tested products will be acceptable.

**1.7 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):



E84-10.....Surface Burning Characteristics of Building  
Materials

E814-11.....Fire Tests of Through-Penetration Fire Stops

C. Factory Mutual Engineering and Research Corporation (FM):

Annual Issue Approval Guide Building Materials

D. Underwriters Laboratories, Inc. (UL):

Annual Issue Building Materials Directory

Annual Issue Fire Resistance Directory

1479-10.....Fire Tests of Through-Penetration Firestops

E. Warnock Hersey (WH):

Annual Issue Certification Listings

## **PART 2 - PRODUCTS**

### **2.1 FIRESTOP SYSTEMS**

- A. Use either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke.
- B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 100 mm (4 in) nominal pipe or 0.01 m<sup>2</sup> (16 sq. in.) in overall cross sectional area.
- C. Products requiring heat activation to seal an opening by its intumescence shall exhibit a demonstrated ability to function as designed to maintain the fire barrier.
- D. Firestop sealants used for firestopping or smoke sealing shall have following properties:
  - 1. Contain no flammable or toxic solvents.
  - 2. Have no dangerous or flammable out gassing during the drying or curing of products.
  - 3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
  - 4. When used in exposed areas, shall be capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

- E. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall have following properties:
  - 1. Classified for use with the particular type of penetrating material used.
  - 2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.
  - 3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and, water sealant.
- F. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.
- G. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- H. Materials to be asbestos free.

## **2.2 SMOKE STOPPING IN SMOKE PARTITIONS**

- A. Use silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.
- B. Use mineral fiber filler and bond breaker behind sealant.
- C. Sealants shall have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with E84.
- D. When used in exposed areas capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

Submit product data and installation instructions, as required by article, submittals, after an on site examination of areas to receive firestopping.

### **3.2 PREPARATION**

- A. Remove dirt, grease, oil, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.
- B. Remove insulation on insulated pipe for a distance of 150 mm (six inches) on either side of the fire rated assembly prior to applying the

firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.

### **3.3 INSTALLATION**

- A. Do not begin work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.
- B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.
- C. Install smoke stopping seals in smoke partitions.

### **3.4 CLEAN-UP AND ACCEPTANCE OF WORK**

- A. As work on each floor is completed, remove materials, litter, and debris.
- B. Do not move materials and equipment to the next-scheduled work area until completed work is inspected and accepted by the COR.
- C. Clean up spills of liquid type materials.

### **3.5 LABELING OF PARTITIONS**

- A. Label walls as Smoke partition or Fire partition. Label should be stenciled above the ceiling not more than 8 feet apart. Lettering shall be a minimum of 3-inches high, Black.
- B. Label all penetrations sealed as part of the project with UL approved listing. Provide a label at each penetration. Permanently secure label at penetration.

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**SECTION 07 92 00  
JOINT SEALANTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

**1.2 RELATED WORK:**

- A. Firestopping penetrations: Section 07 84 00, FIRESTOPPING.
- B. Glazing: Section 08 80 00, GLAZING.
- C. Sound rated gypsum partitions/sound sealants: Section 09 29 00, GYPSUM BOARD.
- D. Mechanical Work: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

**1.3 QUALITY CONTROL:**

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. VOC: Acrylic latex and Silicon sealants shall have less than 50g/l VOC content.

**1.4 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's installation instructions for each product used.
- C. Cured samples of exposed sealants for each color where required to match adjacent material.
- D. Manufacturer's Literature and Data:
  - 1. Caulking compound
  - 2. Primers
  - 3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

**1.5 PROJECT CONDITIONS:**

A. Environmental Limitations:

1. Do not proceed with installation of joint sealants under following conditions:
  - a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 °C (40 °F).
  - b. When joint substrates are wet.

B. Joint-Width Conditions:

1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions:

1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

**1.6 DELIVERY, HANDLING, AND STORAGE:**

- A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.
- B. Carefully handle and store to prevent inclusion of foreign materials.
- C. Do not subject to sustained temperatures exceeding 32° C (90° F) or less than 5° C (40° F).

**1.7 DEFINITIONS:**

- A. Definitions of terms in accordance with ASTM C717 and as specified.
- B. Back-up Rod: A type of sealant backing.
- C. Bond Breakers: A type of sealant backing.
- D. Filler: A sealant backing used behind a back-up rod.

**1.8 WARRANTY:**

- A. See Solicitation Documents for warranty requirements.

**1.9 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):

C509-06.....Elastomeric Cellular Preformed Gasket and  
Sealing Material.  
C612-10.....Mineral Fiber Block and Board Thermal  
Insulation.  
C717-10.....Standard Terminology of Building Seals and  
Sealants.  
C834-10.....Latex Sealants.  
C919-08.....Use of Sealants in Acoustical Applications.  
C920-10.....Elastomeric Joint Sealants.  
C1021-08.....Laboratories Engaged in Testing of Building  
Sealants.  
C1193-09.....Standard Guide for Use of Joint Sealants.  
C1330-02 (R2007).....Cylindrical Sealant Backing for Use with Cold  
Liquid Applied Sealants.  
D1056-07.....Specification for Flexible Cellular Materials—  
Sponge or Expanded Rubber.  
E84-09.....Surface Burning Characteristics of Building  
Materials.

C. Sealant, Waterproofing and Restoration Institute (SWRI).  
The Professionals' Guide

## **PART 2 - PRODUCTS**

### **2.1 SEALANTS:**

- A. S-1:
  - 1. ASTM C920, polyurethane or polysulfide.
  - 2. Type M.
  - 3. Class 25.
  - 4. Grade NS.
  - 5. Shore A hardness of 20-40
- B. S-2:
  - 1. ASTM C920, polyurethane or polysulfide.
  - 2. Type M.
  - 3. Class 25.
  - 4. Grade P.
  - 5. Shore A hardness of 25-40.
- C. S-3:
  - 1. ASTM C920, polyurethane or polysulfide.

2. Type S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-25.
6. Minimum elongation of 700 percent.

D. S-4:

1. ASTM C920 polyurethane or polysulfide.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-40.

E. S-5:

1. ASTM C920, polyurethane or polysulfide.
2. Type S.
3. Class 25.
4. Grade P.
5. Shore hardness of 15-45.

F. S-6:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-20.
6. Minimum elongation of 1200 percent.

G. S-7:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

H. S-8:

1. ASTM C920, silicone, acetoxycure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.

6. Structural glazing application.

I. S-9:

1. ASTM C920 silicone.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Non-yellowing, mildew resistant.

J. S-10:

1. ASTM C920, coal tar extended fuel resistance polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 15-20.

K. S-11:

1. ASTM C920 polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 35 to 50.

L. S-12:

1. ASTM C920, polyurethane.
2. Type M/S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade P/NS.
5. Shore A hardness of 25 to 50.

## **2.2 CAULKING COMPOUND:**

- A. C-1: ASTM C834, acrylic latex.
- B. C-2: One component acoustical caulking, non drying, non hardening, synthetic rubber.

## **2.3 COLOR:**

- A. Sealants used with exposed masonry shall match color of mortar joints.
- B. Sealants used with unpainted concrete shall match color of adjacent concrete.
- C. Color of sealants for other locations shall be light gray or aluminum, unless specified otherwise.
- D. Caulking shall be light gray or white, unless specified otherwise.



#### **2.4 JOINT SEALANT BACKING:**

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

#### **2.5 FILLER:**

- A. Mineral fiber board: ASTM C612, Class 1.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

#### **2.6 PRIMER:**

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

#### **2.7 CLEANERS-NON POUROUS SURFACES:**

Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION:**

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.

- B. Coordinate for repair and resolution of unsound substrate materials.
- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

### **3.2 PREPARATIONS:**

- A. Prepare joints in accordance with manufacturer's instructions and SWRI.
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
  - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
  - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.

1. Apply primer prior to installation of back-up rod or bond breaker tape.
2. Use brush or other approved means that will reach all parts of joints.

F. Take all necessary steps to prevent three sided adhesion of sealants.

### **3.3 BACKING INSTALLATION:**

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

### **3.4 SEALANT DEPTHS AND GEOMETRY:**

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

### **3.5 INSTALLATION:**

- A. General:
  1. Apply sealants and caulking only when ambient temperature is between 5° C and 38° C (40° and 100° F).
  2. Do not use polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
  3. Do not use sealant type listed by manufacture as not suitable for use in locations specified.
  4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
  5. Avoid dropping or smearing compound on adjacent surfaces.

6. Fill joints solidly with compound and finish compound smooth.
  7. Tool joints to concave surface unless shown or specified otherwise.
  8. Finish paving or floor joints flush unless joint is otherwise detailed.
  9. Apply compounds with nozzle size to fit joint width.
  10. Test sealants for compatibility with each other and substrate. Use only compatible sealant.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
- C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
  2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
  3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
  4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
  5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

### **3.6 FIELD QUALITY CONTROL:**

- A. // Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as recommended by sealant manufacturer:
1. Extent of Testing: Test completed elastomeric sealant joints as follows:
    - a. Perform one test for each 300 m (1000 feet) of joint length thereafter or one test per each floor per elevation. //

**3.7 CLEANING:**

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

**3.8 LOCATIONS:**

- A. Sanitary Joints:
  - 1. Walls to Plumbing Fixtures: Type S-9
  - 2. Counter Tops to Walls: Type S-9
  - 3. Pipe Penetrations: Type S-9
- B. High Temperature Joints over 204 degrees C (400 degrees F):
  - 1. Exhaust Pipes, Flues, Breech Stacks: Type S-7 or S-8
- C. Interior Caulking:
  - 1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1 and C-2.
  - 2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1 and C-2.
  - 3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1 and C-2.
  - 4. Perimeter of Lead Faced Control Windows and Plaster or Gypsum Wallboard Walls: Types C-1 and C-2.
  - 5. Exposed Isolation Joints at Top of Full Height Walls: Types C-1 and C-2.
  - 6. Exposed Acoustical Joint at Sound Rated Partitions Type C-2.
  - 7. Concealed Acoustic Sealant Types S-4, C-1 and C-2.
  - 8. All interior door frames, both sides of frame. Types C-1 and C-2

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**SECTION 08 11 13**  
**HOLLOW METAL DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies steel doors, frames and related components.
- B. Terms relating to steel doors and frames as defined in ANSI A123.1 and as specified.

**1.2 RELATED WORK**

- A. Door Hardware: Section 08 71 00, DOOR HARDWARE.
- B. Glazing: Section 08 80 00, GLAZING.
- C. Card readers and biometric devices: Section 28 13 00, ACCESS CONTROL.

**1.3 TESTING**

An independent testing laboratory shall perform testing.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers Literature and Data:
  - 1. Fire rated doors and frames, showing conformance with NFPA 80 and Underwriters Laboratory, Inc., or Intertek Testing Services or Factory Mutual fire rating requirements and temperature rise rating for stairwell doors. Submit proof of temperature rating.
  - 2. Sound rated doors, including test report from Testing Laboratory.

**1.5 SHIPMENT**

- A. Prior to shipment label each door and frame to show location, size, door swing and other pertinent information.
- B. Fasten temporary steel spreaders across the bottom of each door frame.

**1.6 STORAGE AND HANDLING**

- A. Store doors and frames at the site under cover.
- B. Protect from rust and damage during storage and erection until completion.

**1.7 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
  - L-S-125B.....Screening, Insect, Nonmetallic

- C. Door and Hardware Institute (DHI):  
A115 Series.....Steel Door and Frame Preparation for Hardware,  
Series A115.1 through A115.17 (Dates Vary)
- D. Steel Door Institute (SDI):  
113-01.....Thermal Transmittance of Steel Door and Frame  
Assemblies  
128-09.....Acoustical Performance for Steel Door and Frame  
Assemblies  
A250.8-03 (R2008).....Standard Steel Doors and Frames
- E. American Society for Testing and Materials (ASTM):  
A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel  
Steel Plate, Sheet, and Strip  
A568/568-M-11.....Steel, Sheet, Carbon, and High-Strength, Low-  
alloy, Hot-Rolled and Cold-Rolled  
A1008-10.....Steel, sheet, Cold-Rolled, Carbon, Structural,  
High Strength Low Alloy and High Strength Low  
Alloy with Improved Formability  
D1621-10.....Compressive Properties of Rigid Cellular  
Plastics  
E90-09.....Laboratory Measurement of Airborne Sound  
Transmission Loss of Building Partitions
- F. The National Association Architectural Metal Manufacturers (NAAMM):  
Metal Finishes Manual (AMP 500-06)
- G. National Fire Protection Association (NFPA):  
80-10.....Fire Doors and Fire Windows
- H. Underwriters Laboratories, Inc. (UL):  
Fire Resistance Directory
- I. Intertek Testing Services (ITS):  
Certifications Listings...Latest Edition
- J. Factory Mutual System (FM):  
Approval Guide

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Sheet Steel: ASTM A1008, cold-rolled for panels (face sheets) of doors.
- B. Anchors, Fastenings and Accessories: Fastenings anchors, clips  
connecting members and sleeves from zinc coated steel.

C. Prime Paint: Paint that meets or exceeds the requirements of A250.8.

## **2.2 FABRICATION GENERAL**

### **A. GENERAL:**

1. Follow SDI A250.8 for fabrication of standard steel doors, except as specified otherwise. Doors to receive hardware specified in Section 08 71 00, DOOR HARDWARE. Tolerances as per SDI A250.8. Thickness, 44 mm (1-3/4 inches), unless otherwise shown.
2. Close top edge of exterior doors flush and seal to prevent water intrusion.
3. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.

B. Standard Duty Doors: SDI A250.8, Level 1, Model 2 of size and design shown. Use for interior locations only. Do not use for stairwell doors, security doors and detention doors.

C. Heavy Duty Doors: SDI A250.8, Level 2, Model 2 of size and design shown. Core construction types a, d, or f, for interior doors, and, types b, c, e, or f, for exterior doors.

### **E. Smoke Doors:**

1. Close top and vertical edges flush.
2. Provide seamless vertical edges.
3. Apply Steel astragal to the meeting stile at the active leaf of pair of doors or double egress doors.
4. Provide clearance at head, jamb and sill as specified in NFPA 80.

### **F. Fire Rated Doors (Labeled):**

1. Conform to NFPA 80 when tested by Underwriters Laboratories, Inc., Inchcape Testing Services, or Factory Mutual for the class of door or door opening shown.
2. Fire rated labels of metal, with raised or incised markings of approving laboratory shall be permanently attached to doors.
3. Close top and vertical edges of doors flush. Vertical edges shall be seamless. Apply steel astragal to the meeting stile of the active leaf of pairs of fire rated doors, except where vertical rod exit devices are specified for both leaves swinging in the same direction.
4. Construct fire rated doors in stairwell enclosures for maximum transmitted temperature rise of 230 °C (450 °F) above ambient



temperature at end of 30 minutes of fire exposure when tested in accordance with ASTM E152.

### **2.3 METAL FRAMES**

#### **A. General:**

1. SDI A250.8, 1.3 mm (0.053 inch) thick sheet steel, types and styles as shown or scheduled.
2. Frames for exterior doors: Fabricate from 1.7 mm (0.067 inch) thick galvanized steel conforming to ASTM A525.
3. Frames for labeled fire rated doors and windows.
  - a. Comply with NFPA 80. Test by Underwriters Laboratories, Inc., Inchcape Testing Services, or Factory Mutual.
  - b. Fire rated labels of approving laboratory permanently attached to frames as evidence of conformance with these requirements.  
Provide labels of metal or engraved stamp, with raised or incised markings.
4. Knocked-down frames are not acceptable.

#### **B. Reinforcement and Covers:**

1. SDI A250.8 for, minimum thickness of steel reinforcement welded to back of frames.
2. Provide mortar guards securely fastened to back of hardware reinforcements except on lead-lined frames.

#### **C. Terminated Stops: SDI A250.8.**

#### **D. Glazed Openings:**

- a. Integral stop on exterior, corridor, or secure side of door.
- b. Design rabbet width and depth to receive glazing material or panel shown or specified.

#### **E. Frame Anchors:**

1. Floor anchors:
  - a. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.
  - b. At bottom of jamb use 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive two 6 mm (1/4 inch) floor bolts. Use 50 mm x 50 mm (2 inch by 2 inch) 9 mm by (3/8 inch) clip angle for lead lined frames, drilled for 9 mm (3/8 inch) floor bolts.

- c. Where mullions occur, provide 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two 6 mm (1/4 inch) floor bolts and frame anchor screws.
  - d. Where sill sections occur, provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for 6 mm (1/4 inch) floor bolts and frame anchor screws. Space floor bolts at 50 mm (24 inches) on center.
2. Jamb anchors:
- a. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 600 mm (24 inches) apart, except for fire rated frames space anchors as required by labeling authority.
  - b. Form jamb anchors of not less than 1 mm (0.042 inch) thick steel unless otherwise specified.
  - c. Anchors set in masonry: Use adjustable anchors designed for friction fit against the frame and for extension into the masonry not less than 250 mm (10 inches). Use one of following type:
    - 1) Wire loop type of 5 mm (3/16 inch) diameter wire.
    - 2) T-shape or strap and stirrup type of corrugated or perforated sheet steel.
  - d. Anchors for stud partitions: Either weld to frame or use lock-in snap-in type. Provide tabs for securing anchor to the sides of the studs.
  - e. Anchors for frames set in prepared openings:
    - 1) Steel pipe spacers with 6 mm (1/4 inch) inside diameter welded to plate reinforcing at jamb stops or hat shaped formed strap spacers, 50 mm (2 inches) wide, welded to jamb near stop.
    - 2) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass thru frame and spacers.
    - 3) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.
  - f. Anchors for observation windows and other continuous frames set in stud partitions.
    - 1) In addition to jamb anchors, weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.
    - 2) Anchors spaced 600 mm (24 inches) on centers maximum.

- g. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

## **2.4 SHOP PAINTING**

SDI A250.8.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Plumb, align and brace frames securely until permanent anchors are set.
1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
  2. Use wood spreaders at bottom of frame if the shipping spreader is removed.
  3. Protect frame from accidental abuse.
  4. Where construction will permit concealment, leave the shipping spreaders in place after installation, otherwise remove the spreaders after the frames are set and anchored.
  5. Remove wood spreaders and braces only after the walls are built and jamb anchors are secured.
- B. Floor Anchors:
1. Anchor the bottom of door frames to floor with two 6 mm (1/4 inch) diameter expansion bolts. Use 9 mm (3/8 inch) bolts on lead lined frames.
  2. Power actuated drive pins may be used to secure frame anchors to concrete floors.
- C. Jamb Anchors:
1. Anchors in masonry walls: Embed anchors in mortar. Fill space between frame and masonry wall with grout or mortar as walls are built.
  2. Coat frame back with a bituminous coating prior to lining of grout filling in masonry walls.
  3. Secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.
  4. Frames set in prepared openings of masonry or concrete: Expansion bolt to wall with 6 mm (1/4 inch) expansion bolts through spacers. Where subframes or rough bucks are used, 6 mm (1/4 inch) expansion bolts on 600 mm (24 inch) centers or power activated drive pins 600 mm (24 inches) on centers. Secure two piece frames to subframe or rough buck with machine screws on both faces.

- D. Install anchors for labeled fire rated doors to provide rating as required.
- E. Frames for Sound Rated Doors: Coordinate to line frames for sound rated doors with insulation.
- F. Overhead Bracing (Lead Lined Frames): Where jamb extensions extend to structure above, anchor clip angles with not less than two, 9 mm (3/8 inch) expansion bolts or power actuated drive pins to concrete slab. Weld to steel overhead members.

### **3.2 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE**

Install doors and hardware as specified in Section 08 71 00, DOOR  
HARDWARE.

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**SECTION 08 14 23**  
**CLAD WOOD DOORS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies interior solid core doors with plastic faces.
- B. Section includes fire rated doors.

**1.2 RELATED WORK**

- A. Metal door frames: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- B. Door hardware including hardware location (height): Section 08 71 00, DOOR HARDWARE.
- C. Installation of doors and hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, or Section 08 71 00, DOOR HARDWARE.
- D. Glazing: Section 08 80 00, GLAZING.
- E. Card readers and biometric devices: Section 28 13 00, ACCESS CONTROL

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
  - 1. Show every door in project and schedule location in building.
  - 2. Indicate type, grade, finish and size; include detail of glazing sound gasketing and pertinent details.
  - 3. Provide information concerning specific requirements not included in the manufacturer's literature and data submittal.
- C. Manufacturer's Literature and Data:
  - 1. Labeled fire rated doors showing conformance with NFPA 80.
  - 2. Certification of compliance with formaldehyde content requirements
- D. Laboratory Test Reports:
  - 1. Screw holding capacity test report in accordance with WDMA T.M.10.
  - 2. Split resistance test report in accordance with WDMA T.M.5.
  - 3. Cycle/Slam test report in accordance with WDMA T.M.7.
  - 4. Hinge-Loading test report in accordance with WDMA T.M.8.

**1.4 WARRANTY**

- A. See Solicitation Documents for Warranty requirements.

**1.5 DELIVERY AND STORAGE**

- A. Factory seal doors and accessories in minimum of 6 mill polyethylene bags or cardboard packages which shall remain unbroken during delivery and storage.
- B. Store in accordance with WDMA I.S.1-A, J-1 Job Site Information.
- C. Label package for door opening where used.
- D. Environmental Limitations: Do not deliver, store, or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- E. HVAC systems should be operating and balanced prior to arrival of doors. Acceptable humidity shall be no less than 25% or greater than 55%. Any claim for warp, bow, twist, or telegraphing may be denied if required humidity requirements are not maintained.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. Window and Door Manufacturers Association (WDMA):
  - T.M.5-90.....Split Resistance Test Method
  - T.M.6-08.....Adhesive (Glue Bond) Durability Test Method
  - T.M.7-08.....Cycle-Slam Test Method
  - T.M.8-08.....Hinge Loading Test Method
  - T.M.10-08.....Screwholding Test Method
- C. National Fire Protection Association (NFPA):
  - 80-07.....Protection of Buildings from Exterior Fire
  - 252-08.....Fire Tests of Door Assemblies
- D. ASTM International (ASTM):
  - E90-04.....Laboratory Measurements of Airborne Sound  
Transmission Loss

### **PART 2 - PRODUCTS**

#### **2.1 CLAD WOOD DOORS**

- A. Acceptable Products:
  - 1. C/S Group, Lebanon, NJ; Acrovyn Clad Door System.
  - 2. Other as approved.

## **2.2 DOOR CONSTRUCTION, GENERAL**

### **A. Core**

1. Non-rated, or 20-minute opening: Particleboard, 1-LD-2
2. 45-minute or higher rating: Mineral core
3. Faces: Vinyl acrylic or PVC, minimum 0.03 inch thick
4. Stiles: Hardwood or structural composite lumber.
5. Edges: Match Face

## **2.3 FABRICATION**

- A. Factory fit doors to frame sizes indicated.
- B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame shop drawings, and hardware templates. Verify dimensions and alignment before factory machining.

## **2.3 FINISHES**

- A. Color: As selected.
- B. Top and bottom rails: Factory Sealed

## **2.4 FIRE RATED DOORS**

1. Fire Performance Rating:
  - a. "B" label, 1-1/2 hours.
  - b. "C" label, 3/4 hour.
2. Labels:
  - a. Doors shall conform to the requirements of ASTM E2074, or NFPA 252, and, carry an identifying label from a qualified testing and inspection agency for class of door or opening shown designating fire performance rating.
  - b. Metal labels with raised or incised markings.
3. Performance Criteria for Stiles of doors utilizing standard mortise leaf hinges:
  - a. Hinge Loading: WDMA T.M.8. Average of 10 test samples for Extra Heavy Duty doors.
  - b. Direct screw withdrawal: WDMA T.M.10 for Extra Heavy Duty doors. Average of 10 test samples using a steel, fully threaded #12 wood screw.
  - c. Cycle Slam: 1,000,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with WDMA

T.M.7.

4. Additional Hardware Reinforcement:

- a. Provide fire rated doors with hardware reinforcement blocking.
- b. Size of lock blocks as required to secure hardware specified.
- c. Top, bottom and intermediate rail blocks shall measure not less than 125 mm (five inches) minimum by full core width.
- d. Reinforcement blocking in compliance with manufacturer's labeling requirements.
- e. Mineral material similar to core is not acceptable.

5. Other Core Components: Manufacturer's standard as allowed by the labeling requirements.

6. Provide steel frame approved for use in labeled doors for vision panels.

7. Provide steel astragal on pair of doors.

D. Smoke Barrier Doors:

1. For glazed openings use steel frames approved for use in labeled doors.
2. Provide a steel astragal on one leaf of pairs of doors, including double egress doors.

**2.5 IDENTIFICATION MARK:**

- A. On top edge of door.
- B. Either a stamp, brand or other indelible mark, giving manufacturer's name, door's trade name, construction of door, code date of manufacture and quality.
- C. Accompanied by either of the following additional requirements:
  1. An identification mark or a separate certification including name of inspection organization.
  2. Identification of standards for door, including glue type.
  3. Identification of veneer and quality certification.
  4. Identification of preservative treatment for stile and rail doors.

**2.6 SEALING:**

Give top and bottom edge of doors two coats of catalyzed polyurethane or water resistant sealer before sealing in shipping containers.



## **2.7 DOOR EDGES**

- A. Finish - Edges of door to be PVC-Free high impact resistant engineered Acrovyn 4000 finish containing no persistent bio-accumulative toxicants.
- B. Edges are covered by Lifetime Limited Warranty against damaged, and begins 1 month following original installation.
- C. Edges are to fully wrap the door vertical stiles to eliminate banded edges.
- D. Replaceable edges to be  $\frac{3}{4}$ " thick for proper edge and face protection.
- E. Door edges shall be exclusive of fasteners to improve appearance.
- F. Edges must be flush with face of door thus eliminating raised edges that could be torn off.
- G. Edges are to be extruded to ensure correct appearance and proper door fit.
- H. Edges to be provided as part of the construction of the door from single source manufacturer.

## **2.8 ADHESIVES**

- A. Crossbanding to core adhesives shall be Type II, urea formaldehyde free to improve structural integrity of door.
- B. Door faces are to be applied to the crossbanded core using Type 1 urea formaldehyde free adhesives to eliminate delamination.

# **PART 3 - EXECUTION**

## **3.1 DOOR PREPARATION**

- A. Field, shop or factory preparation: Do not violate the qualified testing and inspection agency label requirements for fire rated doors.
- B. Clearances between Doors and Frames and Floors:
  - 1. Maximum 3 mm (1/8 inch) clearance at the jambs, heads, and meeting stiles, and a 19 mm (3/4 inch) clearance at bottom, except as otherwise specified.
  - 2. Maximum clearance at bottom of sound rated doors, light-proofed doors, doors to operating rooms, and doors designated to be fitted with mechanical seal: 10 mm (3/8 inch).
- C. Provide cutouts for special details required and specified.
- D. Rout doors for hardware using templates and location heights specified in Section, 08 71 00 DOOR HARDWARE.

- E. Fit doors to frame, bevel lock edge of doors 3 mm (1/8 inch) for each 50 mm (two inches) of door thickness.
- F. Immediately after fitting and cutting of doors for hardware, seal cut edges of doors with two coats of water resistant sealer.
- G. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.
- H. Apply a steel astragal on the opposite side of active door on pairs of fire rated doors.
- I. Apply a steel astragal to meeting style of active leaf of pair of doors or double egress smoke doors.

### **3.2 INSTALLATION OF DOORS APPLICATION OF HARDWARE**

Install doors and hardware as specified in this Section.

### **3.3 DOOR PROTECTION**

- A. As door installation is completed, place polyethylene bag or cardboard shipping container over door and tape in place.
- B. Provide protective covering over knobs and handles in addition to covering door.
- C. Maintain covering in good condition until removal is approved by Resident Engineer.

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**SECTION 08 31 13**  
**ACCESS DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

Section specifies access doors or panels.

**1.2 RELATED WORK:**

D. Locations of access doors for duct work cleanouts: Section 23 31 00,  
HVAC DUCTS AND CASINGS, Section 23 37 00, AIR OUTLETS AND INLETS.

**1.3 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS PRODUCT DATA.
- B. Shop Drawings: Access doors, each type, showing construction, location and installation details.
- C. Manufacturer's Literature and Data: Access doors, each type.

**1.4 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A167-99(R-2009).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
  - A1008-10.....Steel Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy
- C. American Welding Society (AWS):
  - D1.3-08.....Structural Welding Code Sheet Steel
- D. National Fire Protection Association (NFPA):
  - 80-10.....Fire Doors and Windows
- E. The National Association of Architectural Metal Manufacturers (NAAMM):
  - AMP 500 Series.....Metal Finishes Manual
- F. Underwriters Laboratories, Inc. (UL):
  - Fire Resistance Directory

**PART 2 - PRODUCTS**

**2.1 FABRICATION, GENERAL**

- A. Fabricate components to be straight, square, flat and in same plane where required.
  - 1. Slightly round exposed edges and without burrs, snags and sharp edges.

2. Exposed welds continuous and ground smooth.
3. Weld in accordance with AWS D1.3.
- B. Number of locks and non-continuous hinges as required to maintain alignment of panel with frame. For fire rated doors, use hinges and locks as required by fire test.
- C. Provide anchors or make provisions in frame for anchoring to adjacent construction. Provide size, number and location of anchors on four sides to secure access door in opening. Provide anchors as required by fire test.

**2.2 ACCESS DOORS, FIRE RATED:**

- A. Shall meet requirements for "B" label 1-1/2 hours with maximum temperature rise of 120 degree C (250 degrees F).
- B. Comply with NFPA 80 and have Underwriters Laboratories Inc., or other nationally recognized laboratory label for Class B opening.
- C. Door Panel: Form of 0.9 mm (0.0359 inch) thick steel sheet, insulated sandwich type construction.
- D. Frame: Form of 1.5 mm (0.0598 inch) thick steel sheet of depth and configuration to suit material and type of construction where installed. Provide frame flange at perimeter where installed in concrete masonry or gypsum board openings.
  1. Weld exposed joints in flange and grind smooth.
  2. Provide frame flange at perimeter where installed in concrete masonry or gypsum board.
- F. Hinge: Continuous steel hinge with stainless steel pin.
- G. Lock:
  1. Self-latching, with provision for fitting flush a standard screw-in type lock cylinder. Lock cylinder specified in Section 08 71 00, DOOR HARDWARE.
  2. Provide latch release device operable from inside of door. Mortise case in door.

**2.3 ACCESS DOORS, FLUSH PANEL:**

- A. Door Panel:
  1. Form of 1.5 mm (0.0598 inch) thick steel sheet.
  2. Reinforce to maintain flat surface.
- B. Frame:

1. Form of 1.5 mm (0.0598 inch) thick steel sheet of depth and configuration to suit material and type of construction where installed.
2. Provide surface mounted units having frame flange at perimeter where installed in concrete, masonry, or gypsum board construction.
3. Weld exposed joints in flange and grind smooth.

C. Hinge:

1. Concealed spring hinge to allow panel to open 175 degrees.
2. Provide removable hinge pin to allow removal of panel from frame.

D. Lock:

1. Flush, screwdriver operated cam lock.

**2.4 FINISH:**

- A. Provide in accordance with NAAMM AMP 500 series on exposed surfaces.
- B. Steel Surfaces: Baked-on prime coat over a protective phosphate coating.
- C. Stainless Steel: No. 4 for exposed surfaces.

**2.5 SIZE:**

Minimum 600 mm (24 inches) square door unless otherwise shown.

**PART 3 - EXECUTION**

**3.1 LOCATION:**

- A. Provide access panels or doors wherever any valves, traps, dampers, cleanouts, and other control items of mechanical, electrical and conveyor work are concealed in wall or partition, or are above ceiling of gypsum board.
- B. Use fire rated doors in fire rated partitions and ceilings.
- C. Use flush panels in partitions and gypsum board or plaster ceilings, except lay-in acoustical panel ceilings or upward access acoustical tile ceilings.

**3.2 INSTALLATION, GENERAL:**

- A. Install access doors in openings to have sides vertical in wall installations, and parallel to ceiling suspension grid or side walls when installed in ceiling.
- B. Set frames so that edge of frames without flanges will finish flush with surrounding finish surfaces.
- C. Set frames with flanges to overlap opening and so that face will be uniformly spaced from the finish surface.

- D. Set recessed panel access doors recessed so that face of surrounding materials will finish on the same plane, when finish in door is installed.

**3.3 ANCHORAGE:**

- A. Secure frames to adjacent construction using anchors attached to frames or by use of bolts or screws through the frame members.
- B. Type, size and number of anchoring device suitable for the material surrounding the opening, maintain alignment, and resist displacement during normal use of access door.
- C. Anchors for fire rated access doors shall meet requirements of applicable fire test.

**3.4 ADJUSTMENT:**

- A. Adjust hardware so that door panel will open freely.
- B. Adjust door when closed so door panel is centered in the frame.

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**SECTION 08 71 00**  
**DOOR HARDWARE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Door hardware and related items necessary for complete installation and operation of doors.

**1.2 RELATED WORK**

- A. Caulking: Section 07 92 00 JOINT SEALANTS.
- B. Application of Hardware: Section 08 14 23 - CLAD WOOD DOORS, Section 08 11 13 - HOLLOW METAL DOORS AND FRAMES, Section 08 71 13.11 - LOW ENERGY DOOR OPERATORS, Section 13 49 00, RADIATION PROTECTION
- C. Painting: Section 09 91 00, PAINTING.
- D. Electrical: Division 26, ELECTRICAL.
- E. Fire Detection: Section 28 31 00, FIRE DETECTION AND ALARM.

**1.3 GENERAL**

- A. All hardware shall comply with UFAS, (Uniform Federal Accessible Standards) unless specified otherwise.
- B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).
- C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.
- D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.
- E. The following items shall be of the same manufacturer, except as otherwise specified:
  - 1. Mortise locksets.
  - 2. Hinges for hollow metal and wood doors.
  - 3. Surface applied overhead door closers.
  - 4. Exit devices.

**1.4 WARRANTY: SEE SOLICITATION DOCUMENTS FOR WARRANTY REQUIREMENTS.**

**1.5 MAINTENANCE MANUALS**

- A. In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS", furnish maintenance manuals and instructions on all door hardware. Provide installation instructions with the submittal documentation.

**1.6 SUBMITTALS**

- A. Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).

- B. Hardware Schedule: Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if fire rated and listed)	ANSI/BHMA Finish Designation

- C. Samples and Manufacturers' Literature:

1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.
2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.

- D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an



independent laboratory, within four years of submittal of reports for approval.

#### **1.7 DELIVERY AND MARKING**

- A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to Resident Engineer for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in COR's office until all other similar items have been installed in project, at which time the Resident Engineer will deliver items on file to Contractor for installation in predetermined locations on the project.

#### **1.8 PREINSTALLATION MEETING**

- A. Convene a preinstallation meeting not less than 30 days before start of installation of door hardware. Require attendance of parties directly affecting work of this section, including Contractor and Installer, COR and VA Locksmith, and Hardware Manufacturer's Representative. Review the following:
1. Inspection of door hardware.
  2. Job and surface readiness.
  3. Coordination with other work.
  4. Protection of hardware surfaces.
  5. Substrate surface protection.
  6. Installation.
  7. Adjusting.
  8. Repair.
  9. Field quality control.
  10. Cleaning.

#### **1.9 INSTRUCTIONS**

- A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mates, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters (e.g., "HW") followed by a number. Each number designates a set of hardware items applicable to a door type.

//B. Keying: All cylinders shall be keyed into existing Grand Master Key System. Cylinders shall be 6 pin type. Keying information shall be furnished at a later date by the COR.

#### 1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.
- B. American Society for Testing and Materials (ASTM):
- F883-04.....Padlocks
  - E2180-07.....Standard Test Method for Determining the  
Activity of Incorporated Antimicrobial Agent(s)  
In Polymeric or Hydrophobic Materials
- C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
- A156.1-06.....Butts and Hinges
  - A156.2-03.....Bored and Pre-assembled Locks and Latches
  - A156.3-08.....Exit Devices, Coordinators, and Auto Flush  
Bolts
  - A156.4-08.....Door Controls (Closers)
  - A156.5-01.....Auxiliary Locks and Associated Products
  - A156.6-05.....Architectural Door Trim
  - A156.8-05.....Door Controls-Overhead Stops and Holders
  - A156.12-05 .....Interconnected Locks and Latches
  - A156.13-05.....Mortise Locks and Latches Series 1000
  - A156.15-06.....Release Devices-Closer Holder, Electromagnetic  
and Electromechanical
  - A156.16-08.....Auxiliary Hardware
  - A156.17-04 .....Self-Closing Hinges and Pivots
  - A156.18-06.....Materials and Finishes
  - A156.21-09.....Thresholds
  - A156.22-05.....Door Gasketing and Edge Seal Systems
  - A156.23-04.....Electromagnetic Locks
  - A156.25-07 .....Electrified Locking Devices
  - A156.26-06.....Continuous Hinges

A156.28-07 .....Master Keying Systems

A156.31-07 .....Electric Strikes and Frame Mounted Actuators

A250.8-03.....Standard Steel Doors and Frames

D. National Fire Protection Association (NFPA):

80-10.....Fire Doors and Fire Windows

101-09.....Life Safety Code

E. Underwriters Laboratories, Inc. (UL):

Building Materials Directory (2008)

## **PART 2 - PRODUCTS**

### **2.1 BUTT HINGES**

A. ANSI A156.1. Provide only three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:

2. Interior Doors: Type A8112/A5112 for doors 900 mm (3 feet) wide or less and Type A8111/A5111 for doors over 900 mm (3 feet) wide. Hinges for doors exposed to high humidity areas (shower rooms, toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.

B. Provide quantity and size of hinges per door leaf as follows:

1. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.

2. Doors up to 900 mm (3 feet) wide, standard weight: 114 mm x 114 mm (4-1/2 inches x 4-1/2 inches) hinges.

3. Doors over 900 mm (3 feet) to 1065 mm (3 feet 6 inches) wide, standard weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).

4. Doors over 1065 mm (3 feet 6 inches) to 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).

5. Provide heavy-weight hinges where specified.

6. At doors weighing 330 kg (150 lbs.) or more, furnish 127 mm (5 inch) high hinges.

C. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

## **2.2 CONTINUOUS HINGES**

- A. ANSI/BHMA A156.26, Grade 1-600.
  - 1. Listed under Category N in BHMA's "Certified Product Directory."
- B. General: Minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete
- C. Continuous, Barrel-Type Hinges: Hinge with knuckles formed around a Teflon-coated 6.35mm (0.25-inch) minimum diameter pin that extends entire length of hinge.
  - 2. Base Metal for Interior Hinges: Stainless steel.
  - 3. Base Metal for Hinges for Fire-Rated Assemblies: Stainless Steel.
  - 4. Provide with non-removable pin (hospital tip option) at lockable outswing doors.
  - 5. Where required to clear adjacent casing, trim, and wall conditions and allow full door swing, provide wide throw hinges of minimum width required.
  - 6. Provide with manufacturer's cut-outs for separate mortised power transfers and/or mortised automatic door bottoms where they occur.
  - 7. Where thru-wire power transfers are integral to the hinge, provide hinge with easily removable portion to allow easy access to wiring connections.
  - 8. Where models are specified that provide an integral wrap-around edge guard for the hinge edge of the door, provide manufacturer's adjustable threaded stud and machine screw mechanism to allow the door to be adjusted within the wrap-around edge guard.

## **2.3 OVERHEAD CLOSERS**

- A. Conform to LCN #4041 (with or without hold open)
- B. Closers shall conform to the following: ANSI A156.4, Grade 1.
  - 1. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
  - 2. Where specified, closer shall have hold-open feature.

3. Size Requirements: Provide multi-size closers, sizes 1 through 6, except where multi-size closer is not available for the required application.
4. Material of closer body shall be forged or cast.
5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.
7. Closers shall have full size metal cover; plastic covers will not be accepted.
8. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.
9. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders.
10. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.
11. Provide parallel arm closers with heavy duty rigid arm.
12. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
13. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
14. All closers shall have a 1 ½" (38mm) minimum piston diameter.

#### **2.4 DOOR STOPS**

- A. Conform to ANSI A156.16.
- B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.
- C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.

- D. Where drywall partitions occur, provide blocking in partition at door stop location.

## **2.5 OVERHEAD DOOR STOPS AND HOLDERS**

- A. Conform to ANSI Standard A156.8. Overhead holders shall be of sizes recommended by holder manufacturer for each width of door. Set overhead holders for 110 degree opening, unless limited by building construction or equipment. Provide Grade 1 overhead concealed slide type: stop-only at rated doors and security doors, hold-open type with exposed hold-open on/off control at all other doors requiring overhead door stops.

## **2.6 LOCKS AND LATCHES**

- A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts.
- B. Lock Cylinders for all locksets shall be Best 6-pin cores, keyway "J or K", Lever = 03, Finish 626, Rose = B, Best Mortise Cylinder IE74-C265-RP3 with 626 Cylinder.

Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device or construction core of allow opening and closing during construction and prior to the installation of final cores.

- C. In addition to above requirements, locks and latches shall comply with following requirements:

1. Mortise Lock and Latch Sets: Schlage L-series mortise lock sets.
  - (L9010: Non-Keyed Passage),
  - (L9040: Non-Keyed Privacy),
  - (L9050P: Keyed Offices),
  - (L9070: Keyed Classrooms),
  - (L9080P: Keyed Storerooms),

2. Conform to ANSI/BHMA A156.13. Mortise locksets shall be Schlage L-series. All locksets and latchsets, shall have lever handles fabricated from cast stainless steel. Provide sectional (lever x rose) lever design matching existing building standard. No substitute lever material shall be accepted. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. All lock cases installed on lead lined doors shall be lead lined before applying final hardware finish. Furnish armored fronts for all mortise locks. Where mortise locks are installed in high-humidity locations or where exposed to the exterior on both sides of the opening, provide non-ferrous mortise lock case.
2. Cylindrical Lock and Latch Sets: levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Provide lever design to match design selected by Architect or to match existing lever design. Where two turn pieces are specified for lock F76, turn piece on inside knob shall lock and unlock inside knob, and turn piece on outside knob shall unlock outside knob when inside knob is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)
3. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.5.
4. Privacy locks in non-mental-health patient rooms shall have an inside thumbturn for privacy and an outside thumbturn for emergency entrance. Single occupancy patient privacy doors shall typically swing out; where such doors cannot swing out, provide center-pivoted doors with rescue hardware (see HW-2B).

## **2.7 ELECTROMAGNETIC LOCKS**

- A. ANSI/BHMA A156.23; electrically powered, of strength and configuration indicated; with electromagnet attached to frame and armature plate attached to door. Listed under Category E in BHMA's "Certified Product Directory."
- 1. Type: Full exterior or full interior, as required by application indicated.
- 2. Strength Ranking: 500 lbf (2224 N).

## **2.8 ELECTRIC STRIKES**

- A. ANSI/ BHMA A156.31 Grade 1.
- B. General: Use fail-secure electric strikes at fire-rated doors.

## **2.9 ARMOR PLATES, KICK PLATES, MOP PLATES AND DOOR EDGING**

- A. Conform to ANSI Standard A156.6.
- B. Provide protective plates as specified below:
  - 1. Kick plates, mop plates and armor plates of metal, Type J100 series.
  - 2. Provide kick plates and mop plates where specified. Kick plates shall be 254 mm (10 inches) high. Mop plates shall be 152 mm (6 inches) high. Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
  - 3. Kick plates and/or mop plates are not required on following door sides:
    - a. Armor plate side of doors;
  - 4. Armor plates for doors are listed under Article "Hardware Sets". Armor plates shall be thickness as noted in the hardware set, 875 mm (35 inches) high and 38 mm (1-1/2 inches) less than width of doors, except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 25 mm (1 inch) less than width of each door. Where top of intermediate rail of door is less than 875 mm (35 inches) from door bottom, extend armor plates to within 13 mm (1/2 inch) of top of intermediate rail.



On doors equipped with panic devices, extend armor plates to within 13 mm (1/2 inch) of panic bolt push bar.

5. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

## **2.10 EXIT DEVICES**

- A. Conform to ANSI Standard A156.3. Exit devices shall be Grade 1; type and function are specified in hardware sets. Provide flush with finished floor strikes for vertical rod exit devices in interior of building. Trim shall have cast satin stainless steel lever handles of design similar to locksets, unless otherwise specified. Provide key cylinders for keyed operating trim and, where specified, cylinder dogging.
- B. Surface vertical rod panics shall only be provided less bottom rod; provide fire pins as required by exit device and door fire labels. Do not provide surface vertical rod panics at exterior doors.
- C. Concealed vertical rod panics shall be provided less bottom rod at interior doors, unless lockable or otherwise specified; provide fire pins as required by exit device and door fire labels. Where concealed vertical rod panics are specified at exterior doors, provide with both top and bottom rods.
- D. Where removable mullions are specified at pairs with rim panic devices, provide mullion with key-removable feature.
- E. At non-rated openings with panic hardware, provide panic hardware with key cylinder dogging feature.
- F. Exit devices for fire doors shall comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.

#### **2.11 FLUSH BOLTS (LEVER EXTENSION)**

- A. Conform to ANSI A156.16. Flush bolts shall be Type L24081 unless otherwise specified. Furnish proper dustproof strikes conforming to ANSI A156.16, for flush bolts required on lower part of doors.
- B. Lever extension manual flush bolts shall only be used at non-fire-rated pairs for rooms only accessed by maintenance personnel.
- C. Face plates for cylindrical strikes shall be rectangular and not less than 25 mm by 63 mm (1 inch by 2-1/2 inches).
- D. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.
- E. Provide extension rods for top bolt where door height exceeds 2184 mm (7 feet 2 inches).

#### **2.12 FLUSH BOLTS (AUTOMATIC)**

- A. Conform to ANSI A156.3. Dimension of flush bolts shall conform to ANSI A115. Bolts shall conform to Underwriters Laboratories, Inc., requirements for fire door hardware. Flush bolts shall automatically latch and unlatch. Furnish dustproof strikes conforming to ANSI A156.16 for bottom flushbolt. Face plates for dustproof strike shall be rectangular and not less than 38 mm by 90 mm (1-1/2 by 3-1/2 inches).
- B. At interior doors, provide auto flush bolts less bottom bolt, unless otherwise specified, except at wood pairs with fire-rating greater than 20 minutes; provide fire pins as required by auto flush bolt and door fire labels.

#### **2.13 PUSH PLATES**

- A. Conform to ANSI A156.6. Metal, Type J302, 200 mm (8 inches) wide by 350 mm (14 inches) high. Provide metal Type J302 plates 100 mm (4 inches wide by 350 mm (14 inches) high) where push plates are specified for doors with stiles less than 200 mm (8 inches) wide. Cut plates for cylinders, and turn pieces where required.

#### **2.14 COORDINATORS**

- A. Conform to ANSI A156.16. Coordinators, when specified for fire doors, shall comply with Underwriters Laboratories, Inc., requirements for fire door hardware. Coordinator may be omitted on exterior pairs of doors where either door will close independently regardless of the position of the other door. Coordinator may be omitted on interior pairs of non-labeled open where open back strike is used. Open back strike shall not be used on labeled doors. Paint coordinators to match

door frames, unless coordinators are plated. Provide bar type coordinators, except where gravity coordinators are required at acoustic pairs. For bar type coordinators, provide filler bars for full width and, as required, brackets for push-side surface mounted closers, overhead stops, and vertical rod panic strikes.

## **2.15 MISCELLANEOUS HARDWARE**

- A. Access Doors (including Sheet Metal, Screen and Woven Wire Mesh Types):  
Except for fire-rated doors and doors to Temperature Control Cabinets, equip each single or double metal access door with Lock Type E76213, conforming to ANSI A156.5. Key locks as directed. Ship lock prepaid to the door manufacturer. Hinges shall be provided by door manufacturer.
- B. Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011 or L03021, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames, lead-lined frames and frames for sound-resistant, lightproof and electromagnetically shielded doors. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors. Provide 4 mutes or silencers for frames for each Dutch type door. Provide 2 mutes for each edge of sliding door which would contact door frame.

## **2.16 FINISHES**

- A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.
- B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.
- C. Miscellaneous Finishes:
  - 2. Hinges --interior doors: 652 or 630.
  - 3. Pivots: Match door trim.
  - 4. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
  - 5. Cover plates for floor hinges and pivots: 630.
  - 6. Other primed steel hardware: 600.

- D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing.
- E. Anti-microbial Coating: All hand-operated hardware (levers, pulls, push bars, push plates, paddles, and panic bars) shall be provided with an anti-microbial/anti-fungal coating that has passed ASTM E2180 tests. Coating to consist of ionic silver (Ag<sup>+</sup>). Silver ions surround bacterial cells, inhibiting growth of bacteria, mold, and mildew by blockading food and respiration supplies.

## **2.17 BASE METALS**

- A. Apply specified U.S. Standard finishes on different base metals as following:

<b>Finish</b>	<b>Base Metal</b>
652	Steel
626	Brass or bronze
630	Stainless steel

## **PART 3 - EXECUTION**

### **3.1 HARDWARE HEIGHTS**

- A. For existing buildings locate hardware on doors at heights to match existing hardware. The Contractor shall visit the site, verify location of existing hardware and submit locations to VA Resident Engineer for approval.
- B. Hardware Heights from Finished Floor:
1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).
  2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
  3. Deadlocks centerline of strike 1219 mm (48 inches).
  4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
  5. Centerline of door pulls to be 1016 mm (40 inches).
  6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
  7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
  8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

### 3.2 INSTALLATION

A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors. Where closers are mounted on doors they shall be mounted with sex nuts and bolts; foot shall be fastened to frame with machine screws.

B. Hinge Size Requirements:

Door Thickness	Door Width	Hinge Height
45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.

D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by Resident Engineer. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

Doors 1500 mm (5 ft) or less in height	2 butts
Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high	3 butts
Doors over 2280 mm (7 feet 6 inches) high	4 butts
Dutch type doors	4 butts
Doors with spring hinges 1370 mm (4 feet 6 inches) high or less	2 butts
Doors with spring hinges over 1370 mm (4 feet 6 inches)	3 butts

- F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.
- G. After locks have been installed; show in presence of Resident Engineer that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Medical Center Director along with the bitting list. Also a copy of the invoice shall be sent to the Resident Engineer for his records.) Installation of locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

### **3.3 FINAL INSPECTION**

- A. Installer to provide letter to VA COR that upon completion, installer has visited the Project and has accomplished the following:
1. Re-adjust hardware.
  2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA personnel.
  3. Identify items that have deteriorated or failed.
  4. Submit written report identifying problems.

### **3.4 DEMONSTRATION**

- A. Demonstrate efficacy of mechanical hardware and electrical, and electronic hardware systems, including adjustment and maintenance procedures, to satisfaction of COR and VA Locksmith.

### **3.5 HARDWARE SETS**

- A. Final hardware sets shall be provided for 100% CD Issue.
- B. Hardware Consultant working on a project will be responsible for providing additional information regarding these hardware sets. The numbers shown in the following sets come from BHMA standards.

#### **ELECTRIC HARDWARE ABBREVIATIONS LEGEND:**

ADO = Automatic Door Operator

EMCH = Electro-Mechanical Closer-Holder

MHO = Magnetic Hold-Open (wall- or floor-mounted)

HW-4C

Each Door to Have:

RATED

Base Bid

1	Continuous Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Hospital Utility Lock	F09 x LEAD-LINED AS REQUIRED x PADDLES POINTING DOWN
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02011/C02021
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
1	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R0Y164

Bid Option #2

1	Continuous Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Hospital Utility Lock	F09 x LEAD-LINED AS REQUIRED x PADDLES POINTING DOWN
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02011/C02021
1	Overhead Stop	C01541-ADJUSTABLE
1	Threshold	J32300 x 57 MM WIDTH (2-1/4 INCHES)
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R0Y164

HW-4Q

Each Door to Have:

NON-RATED

Base Bid

1	Continuous Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Utility Hospital Lock	F09 x LEAD-LINED AS REQUIRED x PADDLES POINTING DOWN
1	Key Cylinder	TYPE AS REQUIRED
1	Armor Plate	J101 x 1.275 MM (0.050 INCH) THICKNESS
2	Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Set Self-Adhesive Seal	R0Y154

Bid Option #2

1	Continuous Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Utility Hospital Lock	F09 x LEAD-LINED AS REQUIRED x PADDLES POINTING DOWN
1	Key Cylinder	TYPE AS REQUIRED
1	Overhead Stop	C01541-ADJUSTABLE
1	Set Self-Adhesive Seal	R0Y154



HW-5D

Each Door to Have:

NON-RATED

Base Bid

Hinges	QUANTITY & TYPE AS REQUIRED
1 Storeroom Lock	F07
1 Kick Plate	J102 (@ STORAGE, EVM, & HAC ROOMS ONLY)
1 Overhead Stop	C01541-ADJUSTABLE
3 Silencers	L03011
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
1 Set Self-Adhesive Seals	R0Y154

Bid Option #2

Hinges	QUANTITY & TYPE AS REQUIRED
1 Storeroom Lock	F07
1 Overhead Stop	C01541-ADJUSTABLE
3 Silencers	L03011
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
1 Set Self-Adhesive Seals	R0Y154

HW-10J

Each [ADO] Pair to Have:

RATED/NON-RATED

Base Bid

1 Continuous Transfer Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1 Continuous Transfer Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1 Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1 Classroom Hospital Lock	F08 x PADDLES POINTING DOWN
1 Electric Unlatch Strike	E09321 (FAIL-SECURE)
1 Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1 Coordinator	TYPE 21A
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 x R0Y154 x THRU-BOLTS
2 Armor Plates	J101 x 1.275 MM (0.050 INCH) THICKNESS
2 Edge Guard (@ Wood Doors)	J208M / J211 (VERIFY), CUT: HARDWARE
2 Overhead Stops	C01541-ADJUSTABLE
1 Set Self-Adhesive Seals	R0Y154

AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

POWER TRANSFERS **SHARED BY ELECTRIC STRIKE AND** RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

Bid Option #2

1	Continuous Transfer Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Continuous Transfer Hinge	x INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Classroom Hospital Lock	F08 x PADDLES POINTING DOWN
1	Electric Unlatch Strike	E09321 (FAIL-SECURE)
1	Power Supply	REGULATED, FILTERED, 24VDC, AMPERAGE AS REQUIRED
1	Coordinator	TYPE 21A
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 x R0Y154 x THRU-BOLTS
2	Overhead Stops	C01541-ADJUSTABLE
1	Set Self-Adhesive Seals	R0Y154

AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

POWER TRANSFERS **SHARED BY ELECTRIC STRIKE AND** RE-ACTIVATION SENSOR WIRING (RE-ACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

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**SECTION 08 71 13**  
**LOW ENERGY POWER ASSIST DOOR OPERATORS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies low energy power assisted automatic operation of swing doors. The door operator system shall be complete including operator, controls, door arm and operator enclosure (header and cover).

**1.2 RELATED WORK**

- A. Sealants; Section 07 92 00, JOINT SEALANTS.
- B. Steel doors; Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- C. Clad Wood Doors; Section 08 14 23, CLAD WOOD DOORS
- D. Door hardware; Section 08 71 00, DOOR HARDWARE.
- E. Glass and glazing of doors and frames; Section 08 80 00, GLAZING.
- F. Electric general wiring, connections and equipment requirements; Division 26, ELECTRICAL.

**1.3 MANUFACTURER'S QUALIFICATIONS**

- A. Power assisted door operators, controls and other equipment shall be products of a manufacturer regularly engaged in manufacturing such equipment for a minimum of three years.
- B. One manufacturer of automatic door equipment shall be used throughout the project.

**1.4 WARRANTY**

- A. See Solicitation Documents for warranty information.

**1.4 MAINTENANCE MANUALS**

In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS," furnish two copies of maintenance manuals and instructions on automatic door operators.

**1.5 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's literature and data describing operators, power units, controls, door hardware and safety devices.
- C. Shop Drawings:  
Showing location of controls and safety devices in relationship to each automatically operated door. This includes templates, wiring diagrams, fabrication details, anchorage and other information to providers of

related work to coordinate the proper installation of the door operators.

#### **1.6 DESIGN CRITERIA**

- A. Power assisted automatic door equipment shall accommodate normal traffic as well as the weight of the doors.
- B. Equipment: UL approved and comply with applicable codes. Motors shall be rated minimum one-quarter horsepower and shall be single phase and 115 volts.
- C. Electrical Wiring; Provide wiring so that only a single power supply is required. Equipment and wiring shall be as specified in Division 26, ELECTRICAL.

#### **1.7 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):  
ICC/ANSI A117.1-03.....Guideline for Accessible and Usable Buildings and Facilities-Providing Accessibility and Usability for Physically Handicapped People
- B. Builders Hardware Manufacturers Association, Inc. (BHMA):  
156.19-07.....Power Assist and Low Energy Power Operated Doors

### **PART 2 - PRODUCTS**

#### **2.1 OPERATORS**

- A. Automatic door operators (**Stanley - No Substitute**) shall be for commercial doors and shall be electromechanical and surface mounted above the door to the header or transom bar. The opening force shall be generated by a permanent magnet DC motor driving a combination spiral bevel/spur gear reducer and transmitted to the door through an arm linkage. Opening speed shall be adjustable and feature dual backcheck control allowing adjustment of backcheck speed and position. Closing shall be by spring force generated by a metal compression spring. The spring shall reduce manual opening force to not more than 67 N (15 lbf). The minimum diameter of spring wire shall be .007mm (172 in.). Under the specified design load of the door, the spring shall be capable of performing 2,000,000 cycles before fracture. Adjustable closing speed and fixed latch speed shall control the door in the

closing cycle. The doors shall be operated manually at any time without damage to the operator or components. Coordinate operator selection with weight of lead-lined doors.

- B. All operators shall have checking mechanism providing cushioning action at last part of door travel, in both opening and closing cycle.

Operators shall recycle doors instantaneously to full open position from any point in closing cycle when control switch is reactivated.

- C. Operator shall be swinging type enclosed in housing. Operator shall open door by energizing motor and shall stop by electrically reducing voltage and stalling motor against mechanical stop. Door shall close by means of spring energy, and close force shall be controlled by gear system and motor being used as dynamic break without power. System shall operate as manual door control in event of power failure. Opening and closing speeds shall be adjustable:

1. Swing Operator Housing: Housing shall be 140 mm (5-1/2 inches) wide by 150 mm (6 inches) high aluminum extrusions with enclosed end caps for application to 100 mm (4 inch) and larger frame systems. All structural sections shall have a minimum thickness of 3.7 mm (0.146 inch) and be fabricated of 6063-T5 aluminum alloy.
2. Swing Power Operator: Completely assembled and sealed unit which shall include helical gear drive transmission, mechanical spring and bearings, all located in cast aluminum case and filled with special lubricant for extreme temperature conditions. A "DC" shunt-wound permanent magnet motor with sealed ball bearings shall be attached to transmission system. Complete unit shall be rubber mounted with provisions for easy maintenance and replacement, without removing door from pivots or frame.
3. Connecting hardware for swing overhead concealed type power operator shall have drive arm attached to door with a pin linkage rotating in a self-lubricating bearing and adjustable slide block, traveling in an interconnected track and top pivot assembly. Top track and pivot assembly shall be fabricated of steel. Door shall not pivot on shaft of operator.
4. Electrical Control: Operator shall have a self contained electrical control unit, including necessary transformers, relays, rectifiers, and other electronic components for proper operation and switching of power operator. Relays shall be plug-in type for individual

replacement and all connecting harnesses shall have interlocking plugs. Control shall also include time delay for normal cycle. Swing door control shall include safe-swing circuit with optional switching which automatically limits power and slows door when approached from the doors swing area.

5. On pairs of doors, operators shall allow either door to be opened manually without the other door opening.

## **2.2 MICROPROCESSOR CONTROLS**

- A. The system shall include a multi-function microprocessor control providing adjustable hold open time (1 - 30 sec.), LED indications for actual position unknown, system status, open obstruction shutdown, activation signal, safety mat/sensor signal, Stop-and-Hold signal, and mode selector switches providing a means for easy field selection of the following functions: push-to-operate, latch assist and stack pressure. Control shall be capable of receiving activation signals from any device with normally open dry contact output.
  1. With push-to-operate function enabled, the control shall provide a means of initiating a self-start activation circuit by slightly pushing the door open at any point in the door swing.
  2. Latch Assist shall provide a two second impulse in the close direction to overcome restrictions with locking devices of pressure differentials, allowing the unit to operate in standard time delay mode, and permitting the door to close from the full open position after the hold time is satisfied. All activation modes shall provide fully adjustable opening speed.
- B. The door shall be held open by low voltage applied to the continuous duty motor. The control shall include an adjustable safety circuit that monitors door operation and shuts the motor off if an open obstruction is sensed. The control shall include a recycle feature the reopens the door if an obstruction is sensed at any point during its closing cycle. The control shall include a standard three position toggle switch with functions for ON, OFF, and HOLD OPEN.

## **2.3 ENCLOSURE**

Operator shall be completely self-contained within an extruded aluminum housing (alloy 6063-T6) to conceal operator mechanism and mounting brackets and with removable access cover with an overall maximum size of 140 mm (5-1/2 inches) wide by 150 mm (6 inches) deep. Header color

shall be integral color anodized/painted to match adjacent storefront/frame finish.

#### **2.4 ACTIVATION DEVICES**

- A. Automatic: Opening cycle shall be activated by a touch-free sensor embedded in wall-mounted plate. Switches shall be installed in a standard 2-gang electrical wall box and placed in a location in compliance with ANSI A117.1. Switches may be wall mounted or mounted on a free standing post or guard rail.
- B. Opening and closing force, measured 25 mm (1 inch) out from the lock stile of the door, shall not exceed 67 N (15 lbf) to stop the door when operating in either direction or cycle.
- C. Opening Time: Doors shall be field adjusted so that opening time to back check or 80 degrees, whichever occurs first, shall be 3 seconds or longer as required in Table 1. Backcheck shall not occur before 60 degrees opening.

Total opening time to fully open shall be as in Table II.

- D. Closing Time:

Doors shall be field adjusted to close from 90 degrees to 10 degrees in 3 seconds or longer as required in Table 1.

- 1. Doors shall be field adjusted to close from 10 degrees to fully close position in not less than 1.5 seconds.
- 2. Doors shall be field adjusted to remain fully open for not less than 5 seconds.
- 3. Table 1 provides speed settings for various widths and weights of doors for obtaining results complying with this paragraph.

- E. Cycle Tests:

- 1. Low Energy Power Operated, Low Energy Power Open and Power Assist Operators shall be cycle tested for 300,000 cycles.
- 2. Use the widest and heaviest door specified as a test specimen. Narrower or lighter doors of the same configurations shall then be considered to meet the cycle test requirements.

#### **Table 1**

Minimum Opening Time to Backcheck or 80 degrees, which ever occurs first and the Minimum Closing Time from 90 degrees to Latch Check or 10 degrees.



"D" Door Leaf Width- mm (inches)	"W" Door Weight in kg (pounds) Matrix Values are in seconds				
	(100) 45.4	(56.7) 125	(68.0) 150	(79.4) 175	(90.7) 200
(762) 30	3.0	3.0	3.0	3.0	3.5
(914) 36	3.0	3.5	3.5	4.0	4.0
(1067) 42	3.5	4.0	4.0	4.5	4.5

Doors of other weights and widths can be calculated using the formula;

$T = DvW/133$  in US units       $T = DvW/2260$  in SI (metric) units

Where: T= Time, seconds

D= Door width, mm (inches)

W= Door weight, kg (lbs)

The values for "T" time have been rounded up to the nearest half second.

These values are based on a kinetic energy of (1.25 lbf-ft).

**Table II**

Total Opening Time to Full Open Position

Backcheck at 60 degrees	Backcheck at 70 degrees	Backcheck at 80 degrees
Table 1 plus 2 seconds	Table 1 plus 1.5 seconds	Table 1 plus 1 second

Note: To determine maximum times from close to full open, the operator shall be adjusted as shown in the chart. Backcheck occurring at a point between positions in Table II shall use the lowest setting. For example, if the backcheck occurs at 75 degrees, the full open shall be the time shown in Table 1 plus 1.5 seconds.

## 2.5 POWER UNITS

Provide separate self-contained electric circuits for automatic operators located on each floor of the building. Interruption or failure of power circuits for operators located on one floor of the building shall not interfere with continuous performance of automatic operated doors located on other floors. Capacity and size of power circuits shall be in accordance with automatic operator manufacturer's specifications.

## **2.6 SAFETY DEVICES**

- A. Time delay switches shall be adjustable between 5 to 60 seconds and shall control closing cycle of doors.
- B. Decals with sign "In" or "Do Not Enter" shall be installed on both faces of each door where shown and shall conform to the requirements of ANSI/BHMA A156.19.
- C. Each swing door shall have installed a motion sensor to detect any person standing in the door swing path and prevent the door from opening.
- D. Motion sensors shall consist of detection modules, factory prepared to be attached to each side of the lock/strike stile, an armored flex link power cable and bracket assembly, factory prepared for attachment to the pivot stile; a logic board and a position encoder which shall mount to the operator. The detection modules shall contain transmitting and receiving diodes and sense multidimensional zones for detection of people and/or objects in the door area. Detection modules shall be high impact, shock resistant zinc castings with tinted lenses. The swing door sensor system shall provide complete operate and safety zone coverage. These zones shall be fully adjusted to meet specific jobsite conditions (sidewalls, adjacent panels, etc.) The system shall not be affected by ultrasonic, ambient light or radios frequencies within the vicinity of the swing door.
- E. Each swing door shall have installed a re-activation sensor mounted on the push-side door face near the top detect any person standing in the door swing path and prevent the door from closing. Wiring for the re-activation sensor between the door and frame shall be concealed in a power transfer device, hinge or pivot provided under Section 08 71 00; wire chase in door provided under door section.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Coordinate installation of equipment with other related work. Manual controls and power disconnect switches shall be recessed or semi-flush mounted in partitions. Secure operator components to adjacent construction with suitable fastenings. Conceal conduits, piping, and electric equipment in finish work.
- B. Install power units in locations shown. Where units are to be mounted on walls, provide metal supports or shelves for the units. All

equipment, including time delay switches, shall be accessible for maintenance and adjustment.

- C. Operators shall be adjusted and must function properly for the type of traffic (pedestrians) expected to pass through doors. Each door leaf of pairs of doors shall open and close in synchronization. On pairs of doors, operators shall allow either door to be opened manually without the other door opening.
- D. Install controls at positions shown and make them convenient for particular traffic expected to pass through openings. Maximum height of push plate wall switches from finished floors shall be 40 inches unless otherwise approved by the COR.

---- END ----

**SECTION 08 80 00**  
**GLAZING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies glass, glazing materials and accessories.

Glazing products specified apply to factory or field glazed items.

**1.2 RELATED WORK**

A. Factory glazed by manufacturer in following units:

1. HOLLOW METAL DOORS AND FRAMES, and Section 08 14 00, WOOD DOORS.
2. Lead glass: Section 13 49 00, RADIATION PROTECTION.

**1.3 LABELS**

A. Permanent labels:

1. Locate in corner for each pane.
2. Label in accordance with ANSI Z97.1 and SGCC (Safety Glass Certification Council) label requirements.
  - a. Tempered glass.

**1.4 PERFORMANCE REQUIREMENTS**

B. Glass Thickness:

1. Select thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with applicable code.
2. Test in accordance with ASTM E 1300.
3. Thicknesses listed are minimum. Coordinate thicknesses with framing system manufacturers.

**1.5 SUBMITTALS**

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Manufacturer's Certificates:

1. Certificates stating that wire glass, meets requirements for safety glazing material as specified in ANSI Z97.1.

C. Warranty:

1. See Solicitation Documents for Warranty Information.

D. Manufacturer's Literature and Data:

1. Glass, each kind required.
6. Glazing cushion.
7. Sealing compound.

E. Samples:

1. Size: 150 mm by 150 mm (6 inches by 6 inches).
2. Tinted glass.

**1.6 DELIVERY, STORAGE AND HANDLING**

- A. Delivery: Schedule delivery to coincide with glazing schedules so minimum handling of crates is required. Do not open crates except as required for inspection for shipping damage.
- B. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.
- C. Handling: Unpack cases following printed instructions on case. Stack individual windows on edge leaned slightly against upright supports with separators between each.

**1.7 PROJECT CONDITIONS**

Field Measurements: Field measure openings before ordering tempered glass products. Be responsible for proper fit of field measured products.

**1.8 WARRANTY**

- A. Warranty: Conform to terms of "Warranty of Construction", FAR clause 52.246-21.

**1.9 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American National Standards Institute (ANSI):
  - Z97.1-04.....Safety Glazing Material Used in Building -  
Safety Performance Specifications and Methods  
of Test.
  - C794-06.....Adhesion-in-Peel of Elastomeric Joint Sealants.
  - C1036-06.....Flat Glass.
  - C1048-04.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated  
and Uncoated Glass.
  - E84-09.....Surface Burning Characteristics of Building  
Materials.
- D. Code of Federal Regulations (CFR):
  - 16 CFR 1201 - Safety Standard for Architectural Glazing Materials;  
1977, with 1984 Revision.

- E. National Fire Protection Association (NFPA):  
80-08.....Fire Doors and Windows.
- F. National Fenestration Rating Council (NFRC)
- G. Safety Glazing Certification Council (SGCC)2009:  
Certified Products Directory (Issued Semi-Annually).
- H. Glass Association of North America (GANA):  
Glazing Manual (Latest Edition)  
Sealant Manual (2008)

## **PART 2 - PRODUCT**

### **2.1 GLASS**

- A. Use thickness stated unless specified otherwise in assemblies.
- B. Clear Glass:
  - 1. ASTM C1036, Type I, Class 1, Quality q3.
  - 2. Thickness, 6 mm (1/4 inch).
- C. Patterned and Wired Flat Glass:
  - 1. ASTM C1036, Type II, Class 1, Form 1, Pattern Pl, Finish Fl, Quality Q6, Mesh m2.
  - 2. Thickness, 6 mm (1/4 inch).

### **2.2 HEAT-TREATED GLASS**

- A. Clear Tempered Glass:
  - 1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
  - 2. Thickness, 6 mm (1/4 inch).

### **2.13 GLAZING ACCESSORIES**

- A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Ferrous metal accessories exposed in the finished work shall have a finish that will not corrode or stain while in service.
- B. Setting Blocks: ASTM C864:
  - 1. Channel shape; having 6 mm (1/4 inch) internal depth.
  - 2. Shore a hardness of 80 to 90 Durometer.
  - 3. Block lengths: 50 mm (two inches) except 100 to 150 mm (four to six inches) for insulating glass.
  - 4. Block width: Approximately 1.6 mm (1/16 inch) less than the full width of the rabbet.
  - 5. Block thickness: Minimum 4.8 mm (3/16 inch). Thickness sized for rabbet depth as required.

C. Glazing Sealants: ASTM C920, silicone neutral cure:

1. Type S.
2. Class 25
3. Grade NS.
4. Shore A hardness of 25 to 30 Durometer.

D. Color:

2. Color of other glazing compounds, gaskets, and sealants which will be exposed in the finished work and unpainted shall be black, gray, or neutral color.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Verification of Conditions:

1. Examine openings for glass and glazing units; determine they are proper size; plumb; square; and level before installation is started.
2. Verify that glazing openings conform with details, dimensions and tolerances indicated on manufacturer's approved shop drawings.

B. Advise Contractor of conditions which may adversely affect glass and glazing unit installation, prior to commencement of installation: Do not proceed with installation until unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. For sealant glazing, prepare glazing surfaces in accordance with GANA-02 Sealant Manual.
- B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.
- C. Shop fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.
- D. Verify that components used are compatible.
- E. Clean and dry glazing surfaces.
- F. Prime surfaces scheduled to receive sealants, as determined by preconstruction sealant-substrate testing.

**3.3 INSTALLATION - GENERAL**

- A. Install in accordance with GANA-01 Glazing Manual and GANA-02 Sealant Manual unless specified otherwise.

- B. Glaze in accordance with recommendations of glazing and framing manufacturers, and as required to meet the Performance Test Requirements specified in other applicable sections of specifications.
- C. Set glazing without bending, twisting, or forcing of units.
- D. Do not allow glass to rest on or contact any framing member.
- E. Glaze doors in a securely fixed or closed and locked position, until sealant, glazing compound, or putty has thoroughly set.
- G. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.
- I. Fire Resistant Glass:
  - 1. Wire glass: Glaze in accordance with NFPA 80.
  - 2. Other fire resistant glass: Glaze in accordance with UL design requirements.

### **3.4 INSTALLATION - DRY METHOD (TAPE AND GASKET SPLINE GLAZING)**

- A. Cut glazing tape to length; install on glazing pane. Seal corners by butting and sealing junctions with butyl sealant.
- B. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Trim protruding tape edge.

### **3.5 REPLACEMENT AND CLEANING**

- A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by Resident Engineer.
- B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.
- C. Leave glass, putty, and other setting material in clean, whole, and acceptable condition.

### **3.6 PROTECTION**

- A. Protect finished surfaces from damage during erection, and after completion of work. Strippable plastic coatings on colored anodized finish are not acceptable.



### 3.7 GLAZING SCHEDULE

A. Fire Resistant Glass:

1. Install clear wire glass in interior fire rated or labeled doors and windows.

B. Tempered Glass:

1. Install in full and half glazed doors unless indicated otherwise.
2. Install in windows, and door sidelights adjacent to doors.

- - - E N D - - -

**SECTION 09 22 16**  
**NON-STRUCTURAL METAL FRAMING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies steel studs wall systems, shaft wall systems, ceiling or soffit suspended or furred framing, wall furring, fasteners, and accessories for the screw attachment of gypsum board, plaster bases or other building boards.

**1.2 RELATED WORK**

- A. Support for wall mounted items: Section 05 50 00, METAL FABRICATIONS.
- B. Ceiling suspension systems for acoustical tile or panels and lay in gypsum board panels: Section 09 51 00 - ACOUSTICAL CEILINGS, Section 09 29 00 - GYPSUM BOARD.

**1.3 TERMINOLOGY**

- A. Description of terms shall be in accordance with ASTM C754, ASTM C11, ASTM C841 and as specified.
- B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by beams, trusses, or bar joists. In interstitial spaces with walk-on floors the underside of the walk-on floor is the underside of structure overhead.
- C. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Studs, runners and accessories.
  - 2. Hanger inserts.
  - 3. Channels (Rolled steel).
  - 4. Furring channels.
  - 5. Screws, clips and other fasteners.
- C. Shop Drawings:
  - 1. Typical ceiling suspension system.
  - 2. Typical metal stud and furring construction system including details around openings and corner details.
  - 3. Typical shaft wall assembly

4. Typical fire rated assembly and column fireproofing showing details of construction same as that used in fire rating test.

D. Test Results: Fire rating test designation, each fire rating required for each assembly.

#### **1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE**

In accordance with the requirements of ASTM C754.

#### **1.6 APPLICABLE PUBLICATIONS**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society For Testing And Materials (ASTM)

A123-09.....Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

A653/A653M-09.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

A641-09.....Zinc-Coated (Galvanized) Carbon Steel Wire

C11-10.....Terminology Relating to Gypsum and Related Building Materials and Systems

C635-07.....Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings

C636-06.....Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

C645-09.....Non-Structural Steel Framing Members

C754-09.....Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

C841-03 (R2008).....Installation of Interior Lathing and Furring

C954-07.....Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

E580-09.....Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint.

## **PART 2 - PRODUCTS**

### **2.1 PROTECTIVE COATING**

Galvanize steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G-60 minimum, per ASTM 123.

### **2.2 STEEL STUDS AND RUNNERS (TRACK)**

- A. ASTM C645, modified for thickness specified and sizes as shown.
  - 1. Use ASTM A525 steel, 0.8 mm (0.0329-inch) thick bare metal (33 mil).
  - 2. Runners same thickness as studs.
- B. Provide not less than two cutouts in web of each stud, approximately 300 mm (12 inches) from each end, and intermediate cutouts on approximately 600 mm (24-inch) centers.
- C. Doubled studs for openings and studs for supporting concrete backer-board.
- D. Studs 3600 mm (12 feet) or less in length shall be in one piece.
- E. Shaft Wall Framing:
  - 1. Conform to rated wall construction.
  - 2. C-H Studs.
  - 3. E Studs.
  - 4. J Runners.
  - 5. Steel Jamb-Strut.

### **2.3 FURRING CHANNELS**

- A. Rigid furring channels (hat shape): ASTM C645.
- B. Resilient furring channels:
  - 1. Not less than 0.45 mm (0.0179-inch) thick bare metal.
  - 2. Semi-hat shape, only one flange for anchorage with channel web leg slotted on anchorage side, channel web leg on other side stiffens fastener surface but shall not contact anchorage surface other channel leg is attached to.
- C. "Z" Furring Channels:
  - 1. Not less than 0.45 mm (0.0179-inch)-thick bare metal, with 32 mm (1-1/4 inch) and 19 mm (3/4-inch) flanges.
  - 2. Web furring depth to suit thickness of insulation with slotted perforations.
- D. Rolled Steel Channels: ASTM C754, cold rolled; or, ASTM C841, cold rolled.

### **2.4 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES**

- A. ASTM C754, except as otherwise specified.

- B. For fire rated construction: Type and size same as used in fire rating test.
- C. Fasteners for steel studs thicker than 0.84 mm (0.033-inch) thick. Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.
- D. Clips: ASTM C841 (paragraph 6.11), manufacturer's standard items. Clips used in lieu of tie wire shall have holding power equivalent to that provided by the tie wire for the specific application.
- E. Concrete ceiling hanger inserts (anchorage for hanger wire and hanger straps): Steel, zinc-coated (galvanized), manufacturers standard items, designed to support twice the hanger loads imposed and the type of hanger used.
- F. Tie Wire and Hanger Wire:
  - 1. ASTM A641, soft temper, Class 1 coating.
  - 2. Gage (diameter) as specified in ASTM C754 or ASTM C841.
- G. Attachments for Wall Furring:
  - 1. Manufacturers standard items fabricated from zinc-coated (galvanized) steel sheet.
  - 2. For concrete or masonry walls: Metal slots with adjustable inserts or adjustable wall furring brackets. Spacers may be fabricated from 1 mm (0.0396-inch) thick galvanized steel with corrugated edges.
- H. Power Actuated Fasteners: Type and size as recommended by the manufacturer of the material being fastened.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION CRITERIA**

- A. Where fire rated construction is required for walls, partitions, columns, beams and floor-ceiling assemblies, the construction shall be same as that used in fire rating test.
- B. Construction requirements for fire rated assemblies and materials shall be as shown and specified, the provisions of the Scope paragraph (1.2) of ASTM C754 and ASTM C841 regarding details of construction shall not apply.

#### **3.2 INSTALLING STUDS**

- A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.
- B. Space studs not more than 610 mm (16 inches) on center.
- C. Cut studs 6 mm to 9 mm (1/4 to 3/8-inch) less than floor to underside of structure overhead when extended to underside of structure overhead.

- D. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.
- E. Extend studs to underside of structure overhead for fire, rated partitions, smoke partitions, shafts, and sound rated partitions.
- F. Openings:
  - 1. Frame jambs of openings in stud partitions and furring with two studs placed back to back or as shown.
  - 2. Fasten back to back studs together with 9 mm (3/8-inch) long Type S pan head screws at not less than 600 mm (two feet) on center, staggered along webs.
  - 3. Studs fastened flange to flange shall have splice plates on both sides approximately 50 X 75 mm (2 by 3 inches) screwed to each stud with two screws in each stud. Locate splice plates at 600 mm (24 inches) on center between runner tracks.
- G. Fastening Studs:
  - 1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with two screws through each end of each stud and flange of runner.
  - 2. Do not fasten studs to top runner track when studs extend to underside of structure overhead.
- H. Chase Wall Partitions:
  - 1. Locate cross braces for chase wall partitions to permit the installation of pipes, conduits, carriers and similar items.
  - 2. Use studs or runners as cross bracing not less than 63 mm (2-1/2 inches wide).
- I. Form control joint, with double studs spaced 13 mm (1/2-inch) apart.

### **3.3 INSTALLING WALL FURRING FOR FINISH APPLIED TO ONE SIDE ONLY**

- A. In accordance with ASTM C754, or ASTM C841 except as otherwise specified or shown.
- B. Wall furring-Stud System:
  - 1. Framed with 63 mm (2-1/2 inch) or narrower studs, 600 mm (16 inches) on center.
  - 2. Brace as specified in ASTM C754 for Wall Furring-Stud System or brace with sections or runners or studs placed horizontally at not less than three foot vertical intervals on side without finish.
  - 3. Securely fasten braces to each stud with two Type S pan head screws at each bearing.
- C. Direct attachment to masonry or concrete; rigid channels or "Z" channels:

1. Install rigid (hat section) furring channels at 600 mm (24 inches) on center, horizontally or vertically.
  2. Install "Z" furring channels vertically spaced not more than 600 mm (24 inches) on center.
  3. At corners where rigid furring channels are positioned horizontally, provide mitered joints in furring channels.
  4. Ends of spliced furring channels shall be nested not less than 200 mm (8 inches).
  5. Fasten furring channels to walls with power-actuated drive pins or hardened steel concrete nails. Where channels are spliced, provide two fasteners in each flange.
  6. Locate furring channels at interior and exterior corners in accordance with wall finish material manufacturers printed erection instructions. Locate "Z" channels within 100 mm (4 inches) of corner.
- D. Installing Wall Furring-Bracket System: Space furring channels not more than 400 mm (16 inches) on center.

#### **3.4 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES**

- A. Provide for attachment and support of electrical outlets, plumbing, laboratory or heating fixtures, recessed type plumbing fixture accessories, access panel frames, wall bumpers, wood seats, toilet stall partitions, dressing booth partitions, urinal screens, chalkboards, tackboards, wall-hung casework, handrail brackets, recessed fire extinguisher cabinets and other items like auto door buttons and auto door operators supported by stud construction.
- B. Provide additional studs where required. Install metal backing plates, or special metal shapes as required, securely fastened to metal studs.

#### **3.5 INSTALLING SHAFT WALL SYSTEM**

- A. Conform to UL Design No. U438 for two-hour fire rating.
- B. Position J runners at floor and ceiling with the short leg toward finish side of wall. Securely attach runners to structural supports with power driven fasteners at both ends and 600 mm (24 inches) on center.
- C. After liner panels have been erected, cut C-H studs and E studs, from 9 mm (3/8-inch) to not more than 13 mm (1/2-inch) less than floor-to-ceiling height. Install C-H studs between liner panels with liner panels inserted in the groove.
- D. Install full-length steel E studs over shaft wall line at intersections, corners, hinged door jambs, columns, and both sides of closure panels.
- E. Suitably frame all openings to maintain structural support for wall:
  1. Provide necessary liner fillers and shims to conform to label frame requirements.

2. Frame openings cut within a liner panel with E studs around perimeter.
3. Frame openings with vertical E studs at jambs, horizontal J runner at head and sill.

### **3.6 INSTALLING FURRED AND SUSPENDED CEILINGS OR SOFFITS**

- A. Install furred and suspended ceilings or soffits in accordance with ASTM C754 or ASTM C841 except as otherwise specified or shown for screw attached gypsum board ceilings and for plaster ceilings or soffits.
  1. Space framing at 400 mm (16-inch) centers for metal lath anchorage.
  2. Space framing at 600 mm (24-inch) centers for gypsum board anchorage.
- B. Concrete slabs on steel decking composite construction:
  1. Use pull down tabs when available.
  2. Use power activated fasteners when direct attachment to structural framing can not be accomplished.
- C. Where bar joists or beams are more than 1200 mm (48 inches) apart, provide intermediate hangers so that spacing between supports does not exceed 1200 mm (48 inches). Use clips, bolts, or wire ties for direct attachment to steel framing.
- D. Existing concrete construction exposed or concrete on steel decking:
  1. Use power actuated fasteners either eye pin, threaded studs or drive pins for type of hanger attachment required.
  2. Install fasteners at approximate mid height of concrete beams or joists. Do not install in bottom of beams or joists.
- E. Steel decking without concrete topping:
  1. Do not fasten to steel decking 0.76 mm (0.0299-inch) or thinner.
  2. Toggle bolt to decking 0.9 mm (0.0359-inch) or thicker only where anchorage to steel framing is not possible.
- G. Installing suspended ceiling system for gypsum board (ASTM C635 Option):
  1. Install only for ceilings to receive screw attached gypsum board.
  2. Install in accordance with ASTM C636.
    - a. Install main runners spaced 1200 mm (48 inches) on center.
    - b. Install 1200 mm (four foot) tees not over 600 mm (24 inches) on center; locate for edge support of gypsum board.
    - c. Install wall track channel at perimeter.
- H. Installing Ceiling Bracing System:
  1. Construct bracing of 38 mm (1-1/2 inch) channels for lengths up to 2400 mm (8 feet) and 50 mm (2 inch) channels for lengths over 2400 mm (8 feet) with ends bent to form surfaces for anchorage to carrying channels and over head construction. Lap channels not less than 600



- mm (2 feet) at midpoint back to back. Screw or bolt lap together with two fasteners.
2. Install bracing at an approximate 45 degree angle to carrying channels and structure overhead; secure as specified to structure overhead with two fasteners and to carrying channels with two fasteners or wire ties.

### **3.7 TOLERANCES**

- A. Fastening surface for application of subsequent materials shall not vary more than 3 mm (1/8-inch) from the layout line.
- B. Plumb and align vertical members within 3 mm (1/8-inch.)
- C. Level or align ceilings within 3 mm (1/8-inch.)

- - - E N D - - -

**SECTION 09 29 00**  
**GYPSUM BOARD**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies installation and finishing of gypsum board.

**1.2 RELATED WORK**

- A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: Section 09 22 16 - NON-STRUCTURAL METAL FRAMING.
- B. Acoustical Sealants: Section 07 92 00 - JOINT SEALANTS.
- C. Lay in gypsum board ceiling panels: Section 09 51 00 - ACOUSTICAL CEILING.

**1.3 TERMINOLOGY**

- A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.
- B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by the trusses or bar joists.
- C. "Yoked": Gypsum board cut out for opening with no joint at the opening (along door jamb or above the door).

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Cornerbead and edge trim.
  - 2. Finishing materials.
  - 3. Laminating adhesive.
  - 4. Gypsum board, each type.
- C. Shop Drawings:
  - 1. Typical gypsum board installation, showing corner details, edge trim details and the like.
  - 2. Typical sound rated assembly, showing treatment at perimeter of partitions and penetrations at gypsum board.
  - 3. Typical shaft wall assembly.
  - 4. Typical fire rated assembly and column fireproofing, indicating details of construction same as that used in fire rating test.
- E. Test Results:
  - 1. Fire rating test, each fire rating required for each assembly.

2. Sound rating test.

#### **1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE**

In accordance with the requirements of ASTM C840.

#### **1.6 ENVIRONMENTAL CONDITIONS**

In accordance with the requirements of ASTM C840.

#### **1.7 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing And Materials (ASTM):
- C11-08.....Terminology Relating to Gypsum and Related Building Materials and Systems
  - C475-02.....Joint Compound and Joint Tape for Finishing Gypsum Board
  - C840-08.....Application and Finishing of Gypsum Board
  - C919-08.....Sealants in Acoustical Applications
  - C954-07.....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Stud from 0.033 in. (0.84mm) to 0.112 in. (2.84mm) in thickness
  - C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
  - C1047-05.....Accessories for Gypsum Wallboard and Gypsum Veneer Base
  - C1177-06.....Glass Mat Gypsum Substrate for Use as Sheathing
  - C1658-06.....Glass Mat Gypsum Panels
  - C1396-06.....Gypsum Board
  - E84-08.....Surface Burning Characteristics of Building Materials
- C. Underwriters Laboratories Inc. (UL):
- Latest Edition.....Fire Resistance Directory
- D. Inchcape Testing Services (ITS):
- Latest Editions.....Certification Listings

### **PART 2 - PRODUCTS**

#### **2.1 GYPSUM BOARD**

- A. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick unless shown otherwise. Shall contain a minimum of 20 percent recycled gypsum.
- B. Coreboard or Shaft Wall Liner Panels.

1. ASTM C1396, Type X.
  2. ASTM C1658: Glass Mat Gypsum Panels,
  3. Coreboard for shaft walls 300, 400, 600 mm (12, 16, or 24 inches) wide by required lengths 25 mm (one inch) thick with paper faces treated to resist moisture.
- C. Water Resistant Gypsum Backing Board: ASTM C620, Type X, 16 mm (5/8 inch) thick.
- D. Gypsum cores shall contain a minimum of 95 percent post industrial recycled gypsum content. Paper facings shall contain 100 percent post-consumer recycled paper content.

## **2.2 GYPSUM SHEATHING BOARD**

- A. ASTM C1396, Type X, water-resistant core, 16 mm (5/8 inch) thick.
- B. ASTM C1177, Type X.

## **2.3 ACCESSORIES**

- A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.
- B. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.

## **2.4 FASTENERS**

- A. ASTM C1002 and ASTM C840, except as otherwise specified.
- B. ASTM C954, for steel studs thicker than 0.04 mm (0.33 inch).
- C. Select screws of size and type recommended by the manufacturer of the material being fastened.
- D. For fire rated construction, type and size same as used in fire rating test.
- E. Clips: Zinc-coated (galvanized) steel; gypsum board manufacturer's standard items.

## **2.5 FINISHING MATERIALS AND LAMINATING ADHESIVE**

ASTM C475 and ASTM C840. Free of antifreeze, vinyl adhesives, preservatives, biocides and other VOC. Adhesive shall contain a maximum VOC content of 50 g/l.

## **PART 3 - EXECUTION**

### **3.1 GYPSUM BOARD HEIGHTS**

- A. Extend all layers of gypsum board from floor to underside of structure overhead on following partitions and furring:
1. Two sides of partitions:
    - a. Fire rated partitions.
    - b. Smoke partitions.
    - c. Sound rated partitions.

- d. Full height partitions shown (FHP).
- 2. One side of partitions or furring:
  - a. Inside of exterior wall furring or stud construction.
  - b. Room side of room without suspended ceilings.
  - c. Furring for pipes and duct shafts, except where fire rated shaft wall construction is shown.
- 3. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of interstitial structure overhead, unless shown otherwise.
- B. In locations other than those specified, extend gypsum board from floor to heights as follows:
  - 1. Not less than 100 mm (4 inches) above suspended acoustical ceilings.
  - 2. At ceiling of suspended gypsum board ceilings.
  - 3. At existing ceilings.

### **3.2 INSTALLING GYPSUM BOARD**

- A. Coordinate installation of gypsum board with other trades and related work.
- B. Install gypsum board in accordance with ASTM C840, except as otherwise specified.
- C. Moisture and Mold-Resistant Assemblies: Provide and install moisture and mold-resistant glass mat gypsum wallboard products with moisture-resistant surfaces complying with ASTM C1658 where shown and in locations which might be subject to moisture exposure during construction.
- D. Use gypsum boards in maximum practical lengths to minimize number of end joints.
- E. Bring gypsum board into contact, but do not force into place.
- F. Ceilings:
  - 1. For single-ply construction, use perpendicular application.
  - 2. For two-ply assemblies:
    - a. Use perpendicular application.
    - b. Apply face ply of gypsum board so that joints of face ply do not occur at joints of base ply with joints over framing members.
- G. Walls (Except Shaft Walls):
  - 1. When gypsum board is installed parallel to framing members, space fasteners 300 mm (12 inches) on center in field of the board, and 200 mm (8 inches) on center along edges.
  - 2. When gypsum board is installed perpendicular to framing members, space fasteners 300 mm (12 inches) on center in field and along edges.

3. Stagger screws on abutting edges or ends.
4. For single-ply construction, apply gypsum board with long dimension either parallel or perpendicular to framing members as required to minimize number of joints except gypsum board shall be applied vertically over "Z" furring channels.
5. For two-ply gypsum board assemblies, apply base ply of gypsum board to assure minimum number of joints in face layer. Apply face ply of wallboard to base ply so that joints of face ply do not occur at joints of base ply with joints over framing members.
6. For three-ply gypsum board assemblies, apply plies in same manner as for two-ply assemblies, except that heads of fasteners need only be driven flush with surface for first and second plies. Apply third ply of wallboard in same manner as second ply of two-ply assembly, except use fasteners of sufficient length enough to have the same penetration into framing members as required for two-ply assemblies.
7. No offset in exposed face of walls and partitions will be permitted because of single-ply and two-ply or three-ply application requirements.
8. Installing Two Layer Assembly Over Sound Deadening Board:
  - a. Apply face layer of wallboard vertically with joints staggered from joints in sound deadening board over framing members.
  - b. Fasten face layer with screw, of sufficient length to secure to framing, spaced 300 mm (12 inches) on center around perimeter, and 400 mm (16 inches) on center in the field.
9. Control Joints ASTM C840 and as follows:
  - a. Locate at both side jambs of openings if gypsum board is not "yoked". Use one system throughout.
  - b. Not required for wall lengths less than 9000 mm (30 feet).
  - c. Extend control joints the full height of the wall or length of soffit/ceiling membrane.
- H. Acoustical or Sound Rated Partitions, Fire and Smoke Partitions:
  1. Cut gypsum board for a space approximately 3 mm to 6 mm (1/8 to 1/4 inch) wide around partition perimeter.
  2. Coordinate for application of caulking or sealants to space prior to taping and finishing.
  3. For sound rated partitions, use sealing compound (ASTM C919) to fill the annular spaces between all receptacle boxes and the partition finish material through which the boxes protrude to seal all holes and/or openings on the back and sides of the boxes. STC minimum values as shown.

I. Electrical and Telecommunications Boxes:

1. Seal annular spaces between electrical and telecommunications receptacle boxes and gypsum board partitions.

J. Accessories:

1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
2. Install in one piece, without the limits of the longest commercially available lengths.
3. Corner Beads:
  - a. Install at all vertical and horizontal external corners and where shown.
  - b. Use screws only. Do not use crimping tool.
4. Edge Trim (casings Beads):
  - a. At both sides of expansion and control joints unless shown otherwise.
  - b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.
  - c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.
  - d. Where shown.

**3.3 INSTALLING GYPSUM SHEATHING**

- A. Install in accordance with ASTM C840, except as otherwise specified or shown.
- B. Use screws of sufficient length to secure sheathing to framing.
- C. Space screws 9 mm (3/8 inch) from ends and edges of sheathing and 200 mm (8 inches) on center. Space screws a maximum of 200 mm (8 inches) on center on intermediate framing members.
- D. Apply 600 mm by 2400 mm (2 foot by 8 foot) sheathing boards horizontally with tongue edge up.
- E. Apply 1200 mm by 2400 mm or 2700 mm (4 ft. by 8 ft. or 9 foot) gypsum sheathing boards vertically with edges over framing.

**3.4 CAVITY SHAFT WALL**

- A. Coordinate assembly with Section 09 22 16, NON-STRUCTURAL METAL FRAMING, for erection of framing and gypsum board.
- B. Conform to UL Design No. U438 or FM WALL CONSTRUCTION 12-2/HR (Nonbearing for two-hour fire rating. // Conform to FM WALL CONSTRUCTION 25-1/HR (Non-loadbearing) for one-hour fire rating where shown.

- C. Cut coreboard (liner) panels 25 mm (one inch) less than floor-to-ceiling height, and erect vertically between J-runners on shaft side.
  - 1. Where shaft walls exceed 4300 mm (14 feet) in height, position panel end joints within upper and lower third points of wall.
  - 2. Stagger joints top and bottom in adjacent panels.
  - 3. After erection of J-struts of opening frames, fasten panels to J-struts with screws of sufficient length to secure to framing staggered from those in base, spaced 300 mm (12 inches) on center.
- D. Gypsum Board:
  - 1. Two hour wall:
    - a. Erect base layer (backing board) vertically on finish side of wall with end joints staggered. Fasten base layer panels to studs with 25 mm (one inch) long screws, spaced 600 mm (24 inches) on center.
    - b. Use laminating adhesive between plies in accordance with UL or FM if required by fire test.
    - c. Apply face layer of gypsum board required by fire test vertically over base layer with joints staggered and attach with screws of sufficient length to secure to framing staggered from those in base, spaced 300 mm (12 inches) on center.
  - 2. One hour wall with one layer on finish side of wall: Apply face layer of gypsum board vertically. Attach to studs with screws of sufficient length to secure to framing, spaced 300 mm (12 inches) on center in field and along edges.
  - 3. Where coreboard is covered with face layer of gypsum board, stagger joints of face layer from those in the coreboard base.
- E. Treat joints, corners, and fasteners in face layer as specified for finishing of gypsum board.

### **3.5 FINISHING OF GYPSUM BOARD**

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 4 finish for all finished areas open to public view.
- B. Before proceeding with installation of finishing materials, assure the following:
  - 1. Gypsum board is fastened and held close to framing or furring.
  - 2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.
- C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non decorated, smoke barrier, fire rated and sound rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar



work, seal remaining openings and maintain the integrity of the smoke barrier, fire rated and sound rated construction. Sanding is not required of non decorated surfaces.

### **3.6 REPAIRS**

- A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.
- B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
- C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.
- D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide smoke tight construction, fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction.

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**SECTION 09 51 00**  
**ACOUSTICAL CEILINGS**

**PART 1- GENERAL**

**1.1 DESCRIPTION**

- A. Metal ceiling suspension system for acoustical ceilings.
- B. Acoustical units.
- C. Adhesive application.

**1.2 RELATED WORK**

- A. Color, pattern, and location of each type of acoustical unit:  
In finish schedule on drawings.

**1.3 SUBMITTAL**

- A. Submit in accordance with Section 01 33 23 - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
  - 1. Acoustical units, each type, with label indicating conformance to specification requirements.
  - 2. Colored markers for units providing access.
- C. Manufacturer's Literature and Data:
  - 1. Ceiling suspension system, each type, showing complete details of installation
  - 2. Acoustical units, each type
- D. Manufacturer's Certificates: Acoustical units, each type, in accordance with specification requirements.

**1.4 DEFINITIONS**

- A. Standard definitions as defined in ASTM C634.
- B. Terminology as defined in ASTM E1264.

**1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A641/A641M-03.....Zinc-coated (Galvanized) Carbon Steel Wire
  - A653/A653M-07.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process
  - C423-07.....Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - C634-02 (E2007).....Standard Terminology Relating to Environmental Acoustics

C635-04.....	Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
C636-06.....	Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
E84-07.....	Surface Burning Characteristics of Building Materials
E119-07.....	Fire Tests of Building Construction and Materials
E413-04.....	Classification for Rating Sound Insulation.
E580-06.....	Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint
E1264-(R2005).....	Classification for Acoustical Ceiling Products

## **PART 2- PRODUCTS**

### **2.1 METAL SUSPENSION SYSTEM**

- A. ASTM C635, heavy-duty system, except as otherwise specified.
  - 1. Ceiling suspension system members may be fabricated from either of the following unless specified otherwise.
    - a. Galvanized cold-rolled steel, bonderized.
    - b. Extruded aluminum.
  - 2. Use same construction for cross runners as main runners. Use of lighter-duty sections for cross runners is not acceptable.
- B. Exposed grid suspension system for support of lay-in panels:
  - 1. Exposed grid width not less than 22 mm (7/8 inch) with not less than 8 mm (5/16 inch) panel bearing surface.
  - 2. Fabricate wall molding and other special molding from the same material with same exposed width and finish as the exposed grid members.
  - 3. On exposed metal surfaces apply baked-on enamel flat texture finish in color to match adjacent acoustical units.

### **2.2 PERIMETER SEAL**

- A. Vinyl, polyethylene or polyurethane open cell sponge material having density of 1.3 plus or minus 10 percent, compression set less than 10 percent with pressure sensitive adhesive coating on one side.
- B. Thickness as required to fill voids between back of wall molding and finish wall.
- C. Not less than 9 mm (3/8 inch) wide strip.

### **2.3 WIRE**

- A. ASTM A641.

B. For wire hangers: Minimum diameter 2.68 mm (0.1055 inch).

C. For bracing wires: Minimum diameter 3.43 mm (0.1350 inch).

#### **2.4 ANCHORS AND INSERTS**

A. Use anchors or inserts to support twice the loads imposed by hangers attached thereto.

B. Hanger Inserts:

1. Fabricate inserts from steel, zinc-coated (galvanized after fabrication).

2. Nailing type option for wood forms:

a. Upper portion designed for anchorage in concrete and positioning lower portion below surface of concrete approximately 25 mm (one inch).

b. Lower portion provided with not less than 8 mm (5/16 inch) hole to permit attachment of hangers.

3. Flush ceiling insert type:

a. Designed to provide a shell covered opening over a wire loop to permit attachment of hangers and keep concrete out of insert recess.

b. Insert opening inside shell approximately 16 mm (5/8 inch) wide by 9 mm (3/8 inch) high over top of wire.

c. Wire 5 mm (3/16 inch) diameter with length to provide positive hooked anchorage in concrete.

C. Clips:

1. Galvanized steel.

2. Designed to clamp to steel beam or bar joists, or secure framing member together.

3. Designed to rigidly secure framing members together.

4. Designed to sustain twice the loads imposed by hangers or items supported.

D. Tile Splines: ASTM C635.

#### **2.5 CARRYING CHANNELS FOR SECONDARY FRAMING**

A. Fabricate from cold-rolled or hot-rolled steel, black asphaltic paint finish, free of rust.

B. Weighing not less than the following, per 300 m (per thousand linear feet):

Size mm	Size Inches	Cold-rolled Kg                  Pound		Hot-rolled Kg                  Pound	
38	1 1/2	215.4	475	508	1120
50	2	267.6	590	571.5	1260

## 2.6 ADHESIVE

- A. ASTM D1779, having flame spread index of 25 or less when tested in accordance with ASTM E84.
- B. Developing minimum strength of 7 kg/m<sup>2</sup> (one psi) of contact surface 48 hours after installation in temperature of 21 °C (70 °F).

## 2.7 ACOUSTICAL UNITS

- A. General:
  - 1. Ceiling Tile shall meet minimum 37% bio-based content in accordance with USDA Bio-Preferred Product requirements.
  - 2. ASTM E1264, weighing 3.6 kg/m<sup>2</sup> (3/4 psf) minimum for mineral fiber panels or tile.
  - 3. Class A Flame Spread: ASTM 84
  - 4. Minimum NRC (Noise Reduction Coefficient): 0.55 unless specified otherwise: ASTM C423.
  - 5. Minimum CAC (Ceiling Attenuation Class): 40-44 range unless specified otherwise: ASTM E413.
  - 6. Manufacturers standard finish, minimum Light Reflectance (LR) coefficient of 0.75 on the exposed surfaces, except as specified otherwise in finish schedule on drawings.
  - 7. Lay-in panels: Sizes as shown, with square edges.
- B. Type III Units - Mineral base with water-based painted finish less than 10 g/l VOC, Form 2 - Water felted, minimum 16 mm (5/8 inch) thick. Mineral base to contain minimum 65 percent recycled content.
- C. Type XX-A Units - Perforated Ceramic Units for Wet Service.
  - 1. Conform to requirements of Part 2 - Article "ACOUSTICAL UNITS," subparagraphs Paragraph A, 1, 2, 3, 4, 5 and 6.
  - 2. Formulated of mineral wool material and fired in a kiln to produce a stable panel which is totally unaffected by moisture even when submerged in water.
  - 3. No damage when subjected to 10 cycles of steam at 135 °C (275 °F) and cooling to 10 °C (50 °F).
  - 4. Minimum of 16 mm (5/8 inch) thick.

5. Not affected when immersed in five percent chlorine solution, except for paint finish.
- D. Type III-A Units - Mineral base with painted finish.
  1. Form 1, modular, cast or molded.
  2. Minimum NRC of 0.75.
  3. Minimum thickness of 19 mm (3/4 inch) and weight of 4.9 Kg/sq m (one pound per square foot).

## **2.9 ACCESS IDENTIFICATION**

- A. Markers:
  1. Use colored markers with pressure sensitive adhesive on one side.
  2. Make colored markers of paper or plastic, 6 to 9 mm (1/4 to 3/8 inch) in diameter.
- B. Use markers of the same diameter throughout building.
- C. Color Code: Use following color markers for service identification:

Color.....	Service
Red.....	Sprinkler System: Valves and Controls
Green.....	Domestic Water: Valves and Controls
Yellow.....	Chilled Water and Heating Water
Orange.....	Ductwork: Fire Dampers
Blue.....	Ductwork: Dampers and Controls
Black.....	Gas: Laboratory, Medical, Air and Vacuum

## **PART 3 EXECUTION**

### **3.1 CEILING TREATMENT**

- A. Treatment of ceilings shall include sides and soffits of ceiling beams, furred work 600 mm (24 inches) wide and over, and vertical surfaces at changes in ceiling heights unless otherwise shown. Install acoustic tiles after wet finishes have been installed and solvents have cured.
- B. Lay out acoustical units symmetrically about center lines of each room or space unless shown otherwise on reflected ceiling plan.
- C. Moldings:
  1. Install metal wall molding at perimeter of room, column, or edge at vertical surfaces.
  2. Install special shaped molding at changes in ceiling heights and at other breaks in ceiling construction to support acoustical units and to conceal their edges.
- D. Perimeter Seal:
  1. Install perimeter seal between vertical leg of wall molding and finish wall, partition, and other vertical surfaces.

2. Install perimeter seal to finish flush with exposed faces of horizontal legs of wall molding.

E. Existing ceiling:

1. Where extension of existing ceilings occur, match existing.
2. Where acoustical units are salvaged and reinstalled or joined, use salvaged units within a space. Do not mix new and salvaged units within a space which results in contrast between old and new acoustic units.
3. Comply with specifications for new acoustical units for new units required to match appearance of existing units.

### **3.2 CEILING SUSPENSION SYSTEM INSTALLATION**

A. General:

1. Install metal suspension system for acoustical tile and lay-in panels in accordance with ASTM C636, except as specified otherwise.
2. Use direct or indirect hung suspension system or combination thereof as defined in ASTM C635.
3. Support a maximum area of 1.48 m<sup>2</sup> (16 sf) of ceiling per hanger.
4. Prevent deflection in excess of 1/360 of span of cross runner and main runner.
5. Provide extra hangers, minimum of one hanger at each corner of each item of mechanical, electrical and miscellaneous equipment supported by ceiling suspension system not having separate support or hangers.
6. Provide not less than 100 mm (4 inch) clearance from the exposed face of the acoustical units to the underside of ducts, pipe, conduit, secondary suspension channels, concrete beams or joists; and steel beam or bar joist unless furred system is shown,
7. Use main runners not less than 1200 mm (48 inches) in length.
8. Install hanger wires vertically. Angled wires are not acceptable except for seismic restraint bracing wires.

B. Anchorage to Structure:

1. Concrete:

- a. Install hanger inserts and wire loops required for support of hanger wire in concrete forms before concrete is placed. Install hanger wires with looped ends through steel deck if steel deck does not have attachment device.
- b. Use eye pins or threaded studs with screw-on eyes in existing or already placed concrete structures to support hanger wire. Install in sides of concrete beams or joists at mid height.

2. Steel:

- a. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels for attachment of hanger wires.
    - (1) Size and space carrying channels to insure that the maximum deflection specified will not be exceeded.
    - (2) Attach hangers to steel carrying channels, spaced four feet on center, unless area supported or deflection exceeds the amount specified.
  - b. Attach carrying channels to the bottom flange of steel beams spaced not 1200 mm (4 feet) on center before fire proofing is installed. Weld or use steel clips to attach to beam to develop full strength of carrying channel.
  - c. Attach hangers to bottom chord of bar joists or to carrying channels installed between the bar joists when hanger spacing prevents anchorage to joist. Rest carrying channels on top of the bottom chord of the bar joists, and securely wire tie or clip to joist.
- B. Direct Hung Suspension System:
- 1. As illustrated in ASTM C635.
  - 2. Support main runners by hanger wires attached directly to the structure overhead.
  - 3. Maximum spacing of hangers, 1200 mm (4 feet) on centers unless interference occurs by mechanical systems. Use indirect hung suspension system where not possible to maintain hanger spacing.
- C. Indirect Hung Suspension System:
- 1. As illustrated in ASTM C635.
  - 2. Space carrying channels for indirect hung suspension system not more than 1200 mm (4 feet) on center. Space hangers for carrying channels not more than 2400 mm (8 feet) on center or for carrying channels less than 1200 mm (4 feet) on center so as to insure that specified requirements are not exceeded.
  - 3. Support main runners by specially designed clips attached to carrying channels.

### **3.3 ACOUSTICAL UNIT INSTALLATION**

- A. Cut acoustic units for perimeter borders and penetrations to fit tight against penetration for joint not concealed by molding.
- B. Install lay-in acoustic panels in exposed grid with not less than 6 mm (1/4 inch) bearing at edges on supports.
  - 1. Install tile to lay level and in full contact with exposed grid.



2. Replace cracked, broken, stained, dirty, or tile not cut for minimum bearing.

C. Tile in concealed grid upward access suspension system:

1. Install acoustical tile with joints close, straight and true to line, and with exposed surfaces level and flush at joints.
2. Make corners and arises full, and without worn or broken places.
3. Locate acoustical units providing access as specified under Article, ACCESS.

D. Markers:

1. Install markers of color code specified to identify the various concealed piping, mechanical, and plumbing systems.
2. Attach colored markers to exposed grid on opposite sides of the units providing access.
3. Attach marker on exposed ceiling surface of upward access acoustical unit.

**3.5 CLEAN-UP AND COMPLETION**

- A. Replace damaged, discolored, dirty, cracked and broken acoustical units.
- B. Leave finished work free from defects.

- - - E N D - - -

**SECTION 09 65 16**  
**RESILIENT SHEET FLOORING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies the installation of sheet flooring and integral cove base.
- B. Grades of resilient sheet vinyl floor covering without backing having vinyl plastic wearlayer with backing.
- C. Installation of sheet flooring including following:
  - 1. Heat welded seams.
  - 2. Integral cove base: Installed at intersection of floor and vertical surfaces.

**1.2 RELATED WORK**

- A. Color, pattern and texture: in finish schedule on drawings.
- B. Resilient base over base of lockers, equipment and casework: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.
- C. Unbacked vinyl (homogenous) sheet flooring with welded seams: Section 09 65 16, RESILIENT SHEET FLOORING.

**1.3 QUALITY CONTROL-QUALIFICATIONS:**

- A. The Contracting Officer shall approve products or service of proposed manufacturer, suppliers, and installers, and the Contractor shall submit certification that:
  - 1. Heat welded seaming is manufacturer's prescribed method of installation.
  - 2. Installer is approved by manufacturer of materials and has technical qualifications, experience, trained personnel, and facilities to install specified items.
  - 3. Manufacturer's product submitted has been in satisfactory operation, on three installations similar and equivalent in size to this project for three years. Submit list of installations.
- B. The sheet vinyl floor coverings shall meet fire performance characteristics as determined by testing products, per ASTM test method, indicated below by Underwriters Laboratories, Inc. (UL) or another recognized testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Critical Radiant Flux: 0.45 watts per sq. cm or more, Class I, per ASTM E648.
  - 2. Smoke Density: Less than 450 per ASTM E662.

- C. The floor covering manufacturer shall certify that products supplied for installation comply with local regulations controlling use of volatile organic compounds (VOC's).

#### **1.4 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, submit following:
- B. Manufacturer's Literature and Data:
  - 1. Description of resilient material and accessories to be provided.
  - 2. Resilient material manufacturer's recommendations for adhesives, weld rods, sealants, and underlayment.
  - 3. Application and installation instructions.
- C. Samples:
  - 1. Sheet material, 38 mm by 300 mm (1-1/2 inch by 12 inch), of each color and pattern with a welded seam using proposed welding rod.
  - 2. Cap strip and fillet strip, 300 mm (12 inches) for integral base.
  - 3. Shop Drawings and Certificates: Layout of joints showing patterns where joints are expressed, and type and location of obscure type joints. Indicate orientation of directional patterns.
  - 4. Certificates: Quality Control Certificate Submittals and lists specified in paragraph, QUALIFICATIONS.
  - 5. Edge strips: 150 mm (6 inches) long each type.
  - 6. Adhesive, underlayment and primer: Pint container, each type.

#### **1.5 PROJECT CONDITIONS**

- A. Maintain temperature of floor materials and room, where work occurs, above 18 ° C (65 °F) and below 38 °C (100 °F) for 48 hours before, during and for 48 hours after installation. After above period, room temperature shall not fall below 13 °C (55 °F).
- B. Construction in or near areas to receive flooring work shall be complete, dry and cured. Do not install resilient flooring over slabs until they have been cured and are sufficiently dry to achieve a bond with adhesive. Follow flooring manufacturer's recommendations for bond and moisture testing.
- C. Building shall be permanently enclosed. Schedule construction so that floor receives no construction traffic when completed.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- A. Deliver materials to site in original sealed packages or containers; labeled for identification with manufacturer's name and brand.

- B. Deliver sheet flooring full width roll, completely enclosed in factory wrap, clearly marked with the manufacturer's number, type and color, production run number and manufacture date.
- C. Store materials in weathertight and dry storage facility. Protect from damage due to handling, weather, and construction operations before, during and after installation. Store sheet flooring on end with ambient temperatures maintained as recommended by manufacturer.
- D. Store sheet flooring on end.
- E. Move sheet vinyl floor coverings and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

#### **1.7 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society For Testing Materials (ASTM):
  - E648-09.....Critical Radiant Flux of Floor-Covering Systems Using a Radiant Energy Source.
  - E662-09.....Specific Optical Density of Smoke Generated by Solid Materials.
  - F710-08.....Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.
  - F1303-04.....Sheet Vinyl Floor Covering with Backing.
  - F1869-04.....Moisture Vapor Emission Rate of Concrete Subfloor using Anhydrous Calcium Chloride
  - F1913-04.....Sheet Vinyl Flooring without Backing
  - F2170-09.....Determining Relative Humidity in Concrete Floor Slabs using In-situ Probes
- C. Resilient Floor Covering Institute (RFCI):
  - Recommended Work Practices for Removal of Resilient Floor Coverings.

#### **1.8 SCHEDULING**

Interior finish work such as plastering, drywall finishing, concrete, terrazzo, ceiling work, and painting work shall be complete and dry before installation. Mechanical, electrical, and other work above ceiling line shall be completed. Heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

**1.9 WARRANTY (NOT USED)**

**PART 2 - PRODUCTS**

**2.1 SHEET VINYL FLOOR COVERINGS**

- A. Sheet Vinyl Floor Coverings: Smooth face, minimum thickness nominal 2 mm (0.08 inch). Sheet flooring shall conform to ASTM F1913 and material requirements specified in ASTM F1303, Type II, Grade 1, backing classification not applicable. Foam backed sheet flooring is not acceptable.
- B. Size: Provide maximum size sheet vinyl material produced by manufacturer to provide minimum number of joints. Minimum size width acceptable - 1200 mm (48 inches).
- C. Each color and pattern of sheet flooring shall be of same production run.

**2.2 WELDING ROD:**

Product of floor covering manufacturer in color shall match field color of sheet vinyl covering.

**2.3 APPLICATION MATERIALS AND ACCESSORIES**

- A. Floor and Base Adhesive: Type recommended by sheet flooring material manufacturer for conditions of use.
- B. Mastic Underlayment (for concrete floors): Provide products with latex or polyvinyl acetate resins in mix. Condition to be corrected shall determine type of underlayment selected for use.
- C. Base Accessories:
  - 1. Fillet Strip: 19 mm (3/4 inch) radius fillet strip compatible with resilient sheet material.
  - 2. Cap Strip: Extruded flanged zero edge vinyl reducer strip approximately 25 mm (one inch) exposed height with 13 mm (1/2 inch) flange.

**2.4 SHEET FLOORING**

- A. ASTM F1303, Type II, Grade 1, except for backing requirements. Foam backed sheet flooring is not acceptable.
- B. Minimum nominal thickness 2 mm (0.08 inch); 1800 mm (6 ft) minimum width.
- C. Critical Radiant Flux: 0.45 watts per sq.cm or more, Class I, per ASTM E648.
- D. Smoke density: less than 450 per ASTM E662.
- E. Color and pattern of sheet flooring of the same production run.

## **2.5 ADHESIVES**

Water resistant type recommended by the sheet flooring manufacturer for the conditions of use. VOC not to exceed 50g/L

## **2.6 BASE CAP STRIP AND COVE STRIP**

- A. Extruded vinyl compatible with the sheet flooring.
- B. Cap strip "J" shape with feathered edge flange approximately 25 mm (one inch) wide; top designed to receive sheet flooring with 13 mm (1/2 inch) flange lapping top of flooring
- C. Cove strip 70 mm (2-3/4 inch) radius.

## **2.7 LEVELING COMPOUND (FOR CONCRETE FLOORS)**

Provide cementitious products with latex or polyvinyl acetate resins in the mix.

## **2.8 PRIMER (FOR CONCRETE SUBFLOORS)**

As recommended by the adhesive or sheet flooring manufacturer.

## **2.9 EDGE STRIPS**

- A. Extruded aluminum, mill finish, mechanically cleaned.
- B. 28 mm (1-1/8 inch) wide, 6 mm (1/4 inch) thick, bevel one edge to 3 mm (1/8 inch) thick.
- C. Drill and counter sink edge strips for flat head screws. Space holes near ends and approximately 225 mm (9 inches) on center in between.

## **2.10 SEALANT**

- A. As specified in Section 07 92 00, JOINT SEALANTS.
- B. Compatible with sheet flooring.

## **PART 3 - EXECUTION**

### **3.1 PROJECT CONDITIONS**

- A. Maintain temperature of sheet flooring above 36 °C (65 °F), for 48 hours before installation.
- B. Maintain temperature of rooms where sheet flooring work occurs above 36 °C (65 °F), for 48 hours, before installation and during installation.
- C. After installation, maintain temperature at or above 36 °C (65 °F.)
- D. Building is permanently enclosed.
- E. Wet construction in or near areas to receive sheet flooring is complete, dry and cured.

### **3.2 SUBFLOOR PREPARATION**

- A. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710.
  - 1. Installer shall examine surfaces on which resilient sheet flooring is to be installed, and shall advise Contractor, in writing, of areas

- which are unacceptable for installation of flooring material.  
Installer shall advise Contractor which methods are to be used to correct conditions that will impair proper installation. Installation shall not proceed until unsatisfactory conditions have been corrected.
2. Slab substrates dry, free of curing compounds, sealers, hardeners, and other materials which would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by Resilient Floor Covering Institute recommendations in manual RFCI-MRP.
- B. Broom or vacuum clean substrates to be covered by sheet vinyl floor coverings immediately before installation. Following cleaning, examine substrates to determine if there is visually any evidence of moisture, alkaline salts, carbonation, or dust.
- C. Primer: If recommended by flooring manufacturer, prior to application of adhesive, apply concrete slab primer in accordance with manufacturer's directions.
- D. Correct conditions which will impair proper installation, including trowel marks, pits, dents, protrusions, cracks or joints.
- E. Fill cracks, joints, depressions, and other irregularities in concrete with leveling compound.
1. Do not use adhesive for filling or leveling purposes.
  2. Do not use leveling compound to correct imperfections which can be corrected by spot grinding.
  3. Trowel to smooth surface free of trowel marks, pits, dents, protrusions, cracks or joint lines.
- F. Clean floor of oil, paint, dust and deleterious substances. Leave floor dry and cured free of residue from existing curing or cleaning agents.
- G. Moisture Testing: Perform moisture and pH test as recommended by the flooring and adhesive manufacturers. Perform test locations starting on the deepest part of the concrete structure. Proceed with installation only after concrete substrates meet or exceed the manufacturer's requirements. In the absence of specific guidance from the flooring or adhesive manufacturer the following requirements are to be met:
1. Perform moisture vapor emission tests in accordance with ASTM F1869. Proceed with installation only after substrates have a maximum moisture-vapor-emission rate of 1.36 kg of water/92.9 sq. m (3lb of water/1000 sq. ft.) in 24 hours.
  2. Perform concrete internal relative humidity testing using situ probes in accordance with ASTM F2170. Proceed with installation only after

- concrete reaches maximum 75 percent relative humidity level measurement.
- H. Preparation shall include the removal of existing resilient floor and existing adhesive. Do not use solvents to remove adhesives. Coordinate with Asbestos Abatement Section if asbestos abatement procedures will be involved.
- I. Remove existing resilient flooring and adhesive completely in accordance with Resilient Floor Covering Institute recommendations in manual RFCI-WP. Solvents shall not be used.

### **3.3 INSTALLATION OF FLOORING**

- A. Install work in strict compliance with manufacturer's instructions and approved layout drawings.
- B. Maintain uniformity of sheet vinyl floor covering direction and avoid cross seams.
- C. Arrange for a minimum number of seams and place them in inconspicuous and low traffic areas, but in no case less than 150 mm (6 inches) away from parallel joints in flooring substrates.
- D. Match edges of resilient floor coverings for color shading and pattern at seams.
- E. Where resilient sheet flooring abuts other flooring material floors shall finish level.
- F. Extend sheet vinyl floor coverings into toe spaces, door reveals, closets, and similar openings.
- G. Inform the Resident Engineer of conflicts between this section and the manufacturer's instructions or recommendations for auxiliary materials, or installation methods, before proceeding.
- H. Install sheet in full coverage adhesives.
1. Air pockets or loose edges will not be accepted.
  2. Trim sheet materials to touch in the length of intersection at pipes and vertical projections; seal joints at pipe with waterproof cement or sealant.
- I. Keep joints to a minimum; avoid small filler pieces or strips.
- J. Follow manufacturer's recommendations for seams at butt joints. Do not leave any open joints that would be readily visible from a standing position.
- K. Follow manufacturer's recommendations regarding pattern match, if applicable.
- L. Installation of Edge Strips:
1. Locate edge strips under center lines of doors unless otherwise indicated.



2. Set aluminum strips in adhesive, anchor with lead anchors and stainless steel Phillips screws.

M. Integral Cove Base Installation:

1. Set preformed fillet strip to receive base.
2. Install the base with adhesive, terminate exposed edge with the cap strip.
3. Form internal and external corners to the geometric shape generated by the cove at either straight or radius corners.
4. Solvent weld joints as specified for the flooring. Seal cap strip to wall with an adhesive type sealant.
5. Unless otherwise specified or shown where sheet flooring is scheduled, provide integral base at intersection of floor and vertical surfaces. Provide sheet flooring and base scheduled for room on floors and walls under and behind areas where casework, laboratory and pharmacy furniture and other equipment occurs, except where mounted in wall recesses.

**3.4 INSTALLATION OF INTEGRAL COVED BASE**

- A. Set preformed cove to receive base. Install base material with adhesive and terminate exposed edge with cap strip. Integral base height as shown on drawings.
- B. Internal and external corners shall be formed to geometric shape generated by cove at either square or radius corners.

**3.5 WELDING**

- A. Heat weld all joints of flooring and base using equipment and procedures recommended by flooring manufacturer.
- B. Welding shall consist of routing joint, inserting a welding rod into routed space, and terminally fusing into a homogeneous joint.
- C. Upon completion of welding, surface across joint shall finish flush, free from voids, and recessed or raised areas.
- D. Fusion of Material: Joint shall be fused a minimum of 65 percent through thickness of material, and after welding shall meet specified characteristics for flooring.

**3.6 CLEANING**

- A. Clean small adhesive marks during application of sheet flooring and base before adhesive sets, excessive adhesive smearing will not be accepted.
- B. Remove visible adhesive and other surface blemishes using methods and cleaner recommended by floor covering manufacturers.
- C. Clean and polish materials per flooring manufacturer's written recommendations.

- D. Vacuum floor thoroughly.
- E. Do not wash floor until after period recommended by floor covering manufacturer and then prepare in accordance with manufacturer's recommendations.
- F. Upon completion, COR shall inspect floor and base to ascertain that work was done in accordance with manufacturer's printed instructions.
- G. Perform initial maintenance according to flooring manufacturer's written recommendations.

**3.7 PROTECTION:**

- A. Protect installed flooring as recommended by flooring manufacturer against damage from rolling loads, other trades, or placement of fixtures and furnishings.
- B. Keep traffic off sheet flooring for 24 hours after installation.
- C. Where construction traffic is anticipated, cover sheet flooring with reinforced kraft paper properly secured and maintained until removal is authorized by the COR.
- D. Where protective materials are removed and immediately prior to acceptance, repair any damage, re-clean sheet flooring, lightly re-apply polish and buff floor.

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**SECTION 09 91 00**  
**PAINTING**

**PART 1-GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies field painting.
- B. Section specifies prime coats which may be applied in shop under other sections.
- C. Painting includes, coatings specified, and identity markings.

**1.2 RELATED WORK**

- A. Shop prime painting of steel and ferrous metals: Division 05 - METALS, Division 08 - OPENINGS, Division 10 - SPECIALTIES, Division 12 - FURNISHINGS, Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY sections.
- B. Contractor option: Prefinished flush doors with transparent finishes: Section 08 14 00 - WOOD DOORS.
- C. Type of Finish, Color, and Gloss Level of Finish Coat: See finish schedule on drawings.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Manufacturer's Literature and Data:  
Before work is started, or sample panels are prepared, submit manufacturer's literature, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- D. Sample of identity markers if used.
- E. Manufacturers' Certificates indicating compliance with specified requirements:
  - 1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
  - 2. Epoxy coating.

#### 1.4 DELIVERY AND STORAGE

- A. Deliver materials to site in manufacturer's sealed container marked to show following:
  - 1. Name of manufacturer.
  - 2. Product type.
  - 3. Batch number.
  - 4. Instructions for use.
  - 5. Safety precautions.
- B. In addition to manufacturer's label, provide a label legibly printed as following:
  - 1. Federal Specification Number, where applicable, and name of material.
  - 2. Surface upon which material is to be applied.
  - 3. If paint or other coating, state coat types; prime, body or finish.
- C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.
- D. Store materials at site at least 24 hours before using, at a temperature between 18 and 30 degrees C (65 and 85 degrees F).

#### 1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. American Conference of Governmental Industrial Hygienists (ACGIH):
  - ACGIH TLV-BKLT-2012.....Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
  - ACGIH TLV-DOC-2012.....Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
- C. American National Standards Institute (ANSI):
  - A13.1-07.....Scheme for the Identification of Piping Systems
- D. American Society for Testing and Materials (ASTM):
  - D260-86.....Boiled Linseed Oil
- E. Commercial Item Description (CID):
  - A-A-1555.....Water Paint, Powder (Cementitious, White and Colors) (WPC) (cancelled)
- F. Master Painters Institute (MPI):
  - No. 18-12.....Organic Zinc Rich Primer
  - No. 26-12.....Cementitious Galvanized Metal Primer
  - No. 31-12.....Polyurethane, Moisture Cured, Clear Gloss (PV)
  - No. 43-12.....Interior Satin Latex, MPI Gloss Level 4

No. 44-12.....Interior Low Sheen Latex, MPI Gloss Level 2  
No. 45-12.....Interior Primer Sealer  
No. 47-12.....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5 (AK)  
No. 48-12.....Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)  
No. 49-12.....Interior Alkyd, Flat, MPI Gloss Level 1 (AK)  
No. 50-12.....Interior Latex Primer Sealer  
No. 51-12.....Interior Alkyd, Eggshell, MPI Gloss Level 3  
No. 52-12.....Interior Latex, MPI Gloss Level 3 (LE)  
No. 53-12.....Interior Latex, Flat, MPI Gloss Level 1 (LE)  
No. 54-12.....Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)  
No. 59-12.....Interior/Exterior Alkyd Porch & Floor Enamel, Low  
Gloss (FE)  
No. 77-12.....Epoxy Cold Cured, Gloss (EC)  
No. 95-12.....Fast Drying Metal Primer  
No. 114-12.....Interior Latex, Gloss (LE) and (LG)

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Wood Sealer: MPI 31 (gloss) or MPI 71 (flat) thinned with thinner recommended by manufacturer at rate of about one part of thinner to four parts of varnish.
- B. Plastic Tape:
  - 1. Pigmented vinyl plastic film in colors as specified on drawings.
  - 2. Pressure sensitive adhesive back.
  - 3. Widths as shown.
- C. Identity markers options:
  - 1. Pressure sensitive vinyl markers.
  - 2. Snap-on coil plastic markers.
- D. Organic Zinc rich Coating (HR): MPI 22.
- E. High Heat Resistant Coating (HR): MPI 22.
- F. Interior Satin Latex: MPI 43.
- G. Interior Low Sheen Latex: MPI 44.
- H. Interior Primer Sealer: MPI 45.
- J. Interior Alkyd, Semi-Gloss (AK): MPI 47.
- K. Interior Alkyd, Gloss (AK): MPI 49.
- L. Interior Latex Primer Sealer: MPI 50.
- M. Interior Alkyd, Eggshell: MPI 51
- N. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.
- O. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.
- P. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.

- Q. Epoxy Cold Cured, Gloss (EC): MPI 77.
- R. Interior Wood Stain, Semi-Transparent (WS): MPI 90.
- S. Wood Filler Paste: MPI 91.
- T. Fast Drying Metal Primer: MPI 95.
- U. Interior latex, Gloss (LE) and (LG): MPI 114.
- V. Waterborne Galvanized Primer: MPI 134.

## **2.2 PAINT PROPERTIES**

- A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.
- B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

## **2.3 REGULATORY REQUIREMENTS/QUALITY ASSURANCE**

- A. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
  - 1. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed 10g/l for interior latex paints/primers and 50g/l for exterior latex paints and primers.
  - 2. Lead-Base Paint:
    - a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
    - b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
  - 3. Asbestos: Materials shall not contain asbestos.
  - 4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
  - 5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
  - 6. Use high performance acrylic paints in place of alkyd paints, where possible.
  - 7. VOC content for solvent-based paints shall not exceed 250g/l and shall not be formulated with more than one percent aromatic hydro carbons by weight.

### **PART 3 - EXECUTION**

#### **3.1 JOB CONDITIONS**

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
  - 1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
  - 2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each days work.
- B. Atmospheric and Surface Conditions:
  - 1. Do not apply coating when air or substrate conditions are:
    - a. Less than 3 degrees C (5 degrees F) above dew point.
    - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the COR and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.
  - 2. Maintain interior temperatures until paint dries hard.
  - 3. Varnishing:
    - a. Apply in clean areas and in still air.
    - b. Before varnishing vacuum and dust area.
    - c. Immediately before varnishing wipe down surfaces with a tack rag.

#### **3.2 SURFACE PREPARATION**

- A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.
- B. General:
  - 1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
  - 2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
  - 3. See other sections of specifications for specified surface conditions and prime coat.
  - 4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

C. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
  - a. This includes flat head countersunk screws used for permanent anchors.
  - b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.

D. Gypsum Plaster and Gypsum Board:

1. Remove efflorescence, loose and chalking plaster or finishing materials.
2. Remove dust, dirt, and other deterrents to paint adhesion.
3. Fill holes, cracks, and other depressions with CID-A-A-1272A [Plaster, Gypsum (Spackling Compound) finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

**3.3 PAINT PREPARATION**

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.



- D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

### **3.4 APPLICATION**

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by Resident Engineer.
- E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.
- F. Apply by brush, roller or spray, except as otherwise specified.
- G. Do not spray paint in existing occupied spaces.
- H. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

### **3.5 PRIME PAINTING**

- A. After surface preparation prime surfaces before application of body and finish coats, except as otherwise specified.
- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
- C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.
- D. Prime rebates for stop and face glazing of wood, and for face glazing of steel.
- E. Metals except boilers, incinerator stacks, and engine exhaust pipes:
  - 1. Steel and iron: MPI 95 (Fast Drying Metal Primer). Use MPI 101 (Cold Curing Epoxy Primer) where MPI 77 (Epoxy Cold Cured, Gloss (EC)) finish is specified.
  - 2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer).
  - 3. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
  - 4. Terne Metal: MPI 95 (Fast Drying Metal Primer).

5. Copper and copper alloys scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
6. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel (EO)).
7. Asphalt coated metal: MPI 1 (Aluminum Paint (AP)).
8. Metal over 94 degrees C. (200 degrees F), Boilers, Incinerator Stacks, and Engine Exhaust Pipes: MPI 22 (High Heat Resistant Coating (HR)).

F. Gypsum Board:

1. Surfaces scheduled to have: See Finish Schedule.
2. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer).
3. Surfaces scheduled to receive vinyl coated fabric wallcovering: Use MPI 45 (Interior Primer Sealer).
4. Use MPI 101 (Cold Curing Epoxy Primer) for surfaces scheduled to receive MPI 77 (Epoxy Cold Cured, Gloss (EC)) finish.

**3.6 INTERIOR FINISHES**

A. Apply following finish coats over prime coats on surfaces specified.

B. Metal Work:

1. Apply to exposed surfaces.
2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
  - a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) unless specified otherwise.
  - b. Two coats of MPI 48 (Interior Alkyd Gloss (AK)).

C. Gypsum Board:

1. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)).
2. Two coats of MPI 138 (Interior High Performance Latex, MPI Gloss Level 2 (LF)).
3. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 54 (Interior Latex, Semi-Gloss).
4. Sealers:
  - a. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
  - b. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
  - c. Sand as specified.

5. Paint Finish:

- a. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) (SG).
- b. Two coats of MPI 51 (Interior Alkyd, Eggshell) (AK)).

4. Transparent Finishes on Wood Except Floors.

a. Natural Finish:

- 1) One coat of sealer as written in 2.1 E.
- 2) Two coats of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss (PV)).

I. Miscellaneous:

- 1. MPI 1 (Aluminum Paint): Two coats of aluminum paint.
- 2. Interstitial floor markings: One coat MPI 27 (Exterior/ Interior Alkyd Floor Enamel, Gloss (FE)).

**3.7 REFINISHING EXISTING PAINTED SURFACES**

- A. Clean, patch and repair existing surfaces as specified under surface preparation.
- B. Remove and reinstall items as specified under surface preparation.
- C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.
- D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.
- E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.
- F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one coat of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss).
- G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.
- H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.
- I. Sand or dull glossy surfaces prior to painting.
- J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

**3.8 PAINT COLOR**

- A. For additional requirements regarding color see Articles, REFINISHING EXISTING PAINTED SURFACE and MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE.
- B. Coat Colors:

1. Color of priming coat: Lighter than body coat.
  2. Color of body coat: Lighter than finish coat.
  3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.
- C. Painting, Caulking, Closures, and Fillers Adjacent to Casework:
1. Paint to match color of casework where casework has a paint finish.
  2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

### **3.9 MECHANICAL AND ELECTRICAL WORK FIELD PAINTING SCHEDULE**

- A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.
- B. In spaces not scheduled to be finish paint as specified under paragraph H, colors.
- C. Paint various systems specified in Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY.
- D. Paint after tests have been completed.
- E. Omit prime coat from factory prime-coated items.
- F. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.
- G. Omit field painting of items specified in paragraph, Building and Structural WORK NOT PAINTED.
- H. Color:
1. Paint items having no color to match surrounding surfaces.
  2. Paint colors as specified on drawings except for following:
    - a. White .....Exterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.
    - b. Gray: .....Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.

- c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).
  - d. Federal Safety Red: Exposed fire protection piping hydrants, post indicators, electrical conduits containing fire alarm control wiring, and fire alarm equipment.
  - e. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.
  - f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.
- I. Apply paint systems on properly prepared and primed surface as follows:
- 1. Interior Locations:
    - a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) to following items:
      - 1) Metal under 94 degrees C (200 degrees F) of items such as bare piping, fittings, hangers and supports.
      - 2) Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.
      - 3) Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop prime coat and not factory finished.
  - 2. Other exposed locations:
    - a. Metal surfaces, except aluminum, of cooling towers exposed to view, including connected pipes, rails, and ladders: Two coats of MPI 1 (Aluminum Paint (AP)).
    - b. Cloth jackets of insulation of ducts and pipes in connection with plumbing, air conditioning, ventilating refrigeration and heating systems: One coat of MPI 50 (Interior Latex Primer Sealer) and one coat of MPI 10 (Exterior Latex, Flat (AE)).

### **3.10 IDENTITY PAINTING SCHEDULE**

- A. Identify designated service in accordance with ANSI A13.1, unless specified otherwise, on exposed piping, piping above removable ceilings, piping in accessible pipe spaces, interstitial spaces, and piping behind access panels.
  - 1. Legend may be identified using 2.1 G options or by stencil applications.

2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12 000 mm (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
3. Locate Legends clearly visible from operating position.
4. Use arrow to indicate direction of flow.
5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on drawings where asterisk appears for High, Medium, and Low Pressure designations as follows:
  - a. High Pressure - 414 kPa (60 psig) and above.
  - b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).
  - c. Low Pressure - 103 kPa (14 psig) and below.
  - d. Add Fuel oil grade numbers.
6. Legend name in full or in abbreviated form as follows:

PIPING	COLOR OF EXPOSED PIPING	COLOR OF BACKGROUND	COLOR OF LETTERS	LEGEND BBREVIATIONS
Blow-off		Yellow	Black	Blow-off
Boiler Feedwater		Yellow	Black	Blr Feed
A/C Condenser Water Supply		Green	White	A/C Cond Wtr Sup
A/C Condenser Water Return		Green	White	A/C Cond Wtr Ret
Chilled Water Supply		Green	White	Ch. Wtr Sup
Chilled Water Return		Green	White	Ch. Wtr Ret
Shop Compressed Air		Yellow	Black	Shop Air
Air-Instrument Controls		Green	White	Air-Inst Cont
Drain Line		Green	White	Drain
Emergency Shower		Green	White	Emg Shower
High Pressure Steam		Yellow	Black	H.P. _____*
High Pressure Condensate Return		Yellow	Black	H.P. Ret _____*
Medium Pressure Steam		Yellow	Black	M. P. Stm _____*
Medium Pressure Condensate Return		Yellow	Black	M.P. Ret _____*
Low Pressure Steam		Yellow	Black	L.P. Stm _____*
Low Pressure Condensate Return		Yellow	Black	L.P. Ret _____*
High Temperature Water Supply		Yellow	Black	H. Temp Wtr Sup
High Temperature Water Return		Yellow	Black	H. Temp Wtr Ret
Hot Water Heating Supply		Yellow	Black	H. W. Htg Sup

Hot Water Heating Return		Yellow	Black	H. W. Htg Ret
Gravity Condensate Return		Yellow	Black	Gravity Cond Ret
Pumped Condensate Return		Yellow	Black	Pumped Cond Ret
Vacuum Condensate Return		Yellow	Black	Vac Cond Ret
Fuel Oil - Grade		Green	White	Fuel Oil-Grade ____*
Boiler Water Sampling		Yellow	Black	Sample
Chemical Feed		Yellow	Black	Chem Feed
Continuous Blow-Down		Yellow	Black	Cont. B D
Pumped Condensate		Black		Pump Cond
Pump Recirculating		Yellow	Black	Pump-Recirc.
Vent Line		Yellow	Black	Vent
Alkali		Yellow	Black	Alk
Bleach		Yellow	Black	Bleach
Detergent		Yellow	Black	Det
Liquid Supply		Yellow	Black	Liq Sup
Reuse Water		Yellow	Black	Reuse Wtr
Cold Water (Domestic)	White	Green	White	C.W. Dom
Hot Water (Domestic)				
Supply	White	Yellow	Black	H.W. Dom
Return	White	Yellow	Black	H.W. Dom Ret
Tempered Water	White	Yellow	Black	Temp. Wtr
Ice Water				
Supply	White	Green	White	Ice Wtr
Return	White	Green	White	Ice Wtr Ret
Reagent Grade Water		Green	White	RG
Reverse Osmosis		Green	White	RO
Sanitary Waste		Green	White	San Waste
Sanitary Vent		Green	White	San Vent
Storm Drainage		Green	White	St Drain
Pump Drainage		Green	White	Pump Disch
Chemical Resistant Pipe				
Waste		Yellow	Black	Acid Waste
Vent		Yellow	Black	Acid Vent
Atmospheric Vent		Green	White	ATV
Silver Recovery		Green	White	Silver Rec
Oral Evacuation		Green	White	Oral Evac
Fuel Gas		Yellow	Black	Gas
Fire Protection Water				

Sprinkler	Red	White	Auto Spr
Standpipe	Red	White	Stand
Sprinkler	Red	White	Drain

7. Electrical Conduits containing feeders over 600 volts, paint legends using 50 mm (2 inch) high black numbers and letters, showing the voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 6100 mm (20 foot) intervals in between. Use labels with yellow background with black border and words Danger High Voltage Class, // 5000 // 15000 // 25000 //.
8. See Sections for methods of identification, legends, and abbreviations of the following:
  - a. Conduits containing high voltage feeders over 600 volts: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

B. Fire and Smoke Partitions:

1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 64 mm (2 1/2 inches) high.
2. Stenciled message: "SMOKE BARRIER" or, "FIRE BARRIER" as applicable.
3. Locate not more than 6100 mm (20 feet) on center on corridor sides of partitions, and with a least one message per room on room side of partition.
4. Use semigloss paint of color that contrasts with color of substrate.

C. Identify columns in pipe basements and interstitial space:

1. Apply stenciled number and letters to correspond with grid numbering and lettering shown.
2. Paint numbers and letters 100 mm (4 inches) high, locate 450 mm (18 inches) below overhead structural slab.
3. Apply on four sides of interior columns and on inside face only of exterior wall columns.
4. Color:
  - a. Use black on concrete columns.
  - b. Use white or contrasting color on steel columns.

**3.11 PROTECTION CLEAN UP, AND TOUCH-UP**

- A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.



C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

- - - E N D - - -

**SECTION 10 14 00**  
**SIGNAGE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies interior signage for room numbers, directional signs, code required signs, telephone identification signs and temporary interior signs.

**1.2 RELATED WORK**

- A. Electrical: Related Electrical Specification Sections.
- B. Lighted EXIT signs for egress purposes are specified under Division 26, ELECTRICAL.
- C. Color Finish: See drawings for additional information.

**1.3 MANUFACTURER'S QUALIFICATIONS**

Sign manufacturer shall provide evidence that they regularly and presently manufacture signs similar to those specified in this section as one of their principal products.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples: Sign panels and frames, with letters and symbols, each type. Submit 2 sets. One set of samples will be retained by Resident Engineer, other returned to Contractor.
  - 1. Sign Panel, 200 mm x 250 mm (8 inches x 10 inches), with letters.
  - 2. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches. Show anticipated range of color and texture.
  - 3. Sample of typeface, arrow and symbols in a typical full size layout.
- C. Manufacturer's Literature:
  - 1. Showing the methods and procedures proposed for the concealed anchorage of the signage system to each surface type.
  - 2. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions.
- D. Samples: Sign location plan, showing location, type and total number of signs required.
- E. Shop Drawings: Scaled for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.
- F. Full size layout patterns for dimensional letters.

### **1.5 DELIVERY AND STORAGE**

- A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon. Protect materials from damage.
- B. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.
- C. Deliver signs only when the site and mounting services are ready for installation work to proceed.
- D. Store products in dry condition inside enclosed facilities.

### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate
  - B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and tubes.
- C. Federal Specifications (Fed Spec):
  - MIL-PRF-8184F.....Plastic Sheet, Acrylic, Modified.
  - MIL-P-46144C.....Plastic Sheet, Polycarbonate

### **1.7 MINIMUM SIGN REQUIREMENTS**

- A. Permanent Rooms and Spaces:
  - 1. Tactile and Braille Characters, raised minimum 0.793 mm (1/32 in). Characters shall be accompanied by Grade 2 Braille.
  - 2. Type Styles: Characters shall be uppercase, Helvetica Medium, Helvetica Medium Condensed and Helvetica Regular.
  - 3. Character Height: Minimum 16 mm (5/8 in) high, Maximum 50 mm (2 in).
  - 4. Symbols (Pictograms): Equivalent written description shall be placed directly below symbol, outside of symbol's background field. Border dimensions of symbol background shall be minimum 150 mm (6 in) high.
  - 5. Finish and Contrast: Characters and background shall be eggshell, matte or other non-glare finish with adequate contrast with background.
  - 6. Mounting Location and Height: As shown. Mounted on wall adjacent to the latch side of the door and to avoid door swing and protruding objects.
- B. Overhead Signs:

1. Type Styles: As shown. Characters shall have a width-to-height ratio between 3:5 and 1:1. Characters shall have a stroke width-to-height ratio of between 1:5 and 1:10.
2. Character Height: minimum 75 mm (3 in) high for overhead signs. As shown, for directional signs.
3. Finish and Contrast: Same as for signs of permanent rooms and spaces.
4. Mounting Location and Height: As shown.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Signs of type, size and design shown on the drawings and as specified.
- B. Signs complete with lettering, framing and related components for a complete installation.
- C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
- D. Do not scale drawings for dimensions. Contractor to verify and be responsible for all dimensions and conditions shown by these drawings. Resident Engineer to be notified of any discrepancy in drawing, in field directions or conditions, and/or of any changes required for all such construction details.
- E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. The Contractor shall further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

### **2.2 PRODUCTS**

- A. Aluminum:
  1. Sheet and Plate: ASTM B209.
  2. Extrusions and Tubing: ASTM B221.
- B. Cast Acrylic Sheet: MIL-PRF-8184F; Type II, class 1, Water white non-glare optically clear. Matt finish water white clear acrylic shall not be acceptable.
- C. Polycarbonate: MIL-P-46144C; Type I, class 1.
- D. Vinyl: 0.1 mm thick machine cut, having a pressure sensitive adhesive and integral colors.
- E. Laminate: standard grade, high pressure surface laminate.

F. Substrate: Green 209, a natural fiber wood product with SFI certification. The sign shall incorporate balanced construction with the core sandwiched between laminates to prevent warping..

G. Electrical Signs:

1. General: Furnish and install all lighting, electrical components, fixtures and lamps ready for use in accordance with the sign type drawings, details and specifications.
2. Refer to Electrical Specifications Section, Division 26, ELECTRICAL, to verify line voltages for sign locations that require electrical signs.
3. Quality Control: Installed electrical components and sign installations are to bear the label and certification of Underwriter's Laboratories, Inc., and are to comply with National Electrical Code as well as applicable federal, state and local codes for installation techniques, fabrication methods and general product safety.
4. Ballast and Lighting Fixtures: See Electrical Specifications.

## **2.3 SIGN STANDARDS**

A. Topography:

1. Type Style: Helvetica Medium and Helvetica Medium Condensed.
2. Arrow: See drawings.
3. Letter spacing: See drawings.
4. Letter spacing: See drawings.
5. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only; final text for signs is listed in Sign Message Schedule.

B. Project Colors and Finishes: See drawings for additional information.

## **2.4 SIGN TYPES**

A. General:

1. The interior sign system is comprised of sign types families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family.
  - a. IN indicates a component construction based sign.

B. Interchangeable Component System:

1. Sign Type Families: 03, 04, 05, 06, 07, 08, 09 10, 11 12, 13, 14, 15, 16 and 17.
2. Interior sign system capable of being arranged in a variety of configurations with a minimum of attachments, devices and connectors.

- a. Interchangeable nature of the system shall allow for changes of graphic components of the installed sign, without changing sign in its entirety.
  - b. Component Sign System is comprised of the following primary components:
    - 1) Rail Back utilizing horizontal rails, spaced to allow for uniform, modular sizing of sign types.
    - 2) Rail Insert mounted to back of Copy Panels to allow for attachment to Rail Back.
    - 3) Copy Panels, made of a variety of materials to allow for different graphic needs.
    - 4) End Caps which interlock to Rail Back to enclose and secure changeable Copy Panels.
    - 5) Joiners and Accent Joiners connect separate Rail Backs together.
    - 6) Top Accent Bars which provide decorative trim cap that encloses the top of sign or can connect the sign to a Type 03 Room Number Sign.
  - c. Rail Back, Rail Insert and End Caps in anodized extruded aluminum to allow for tight tolerances and consistent quality of fit and finish.
  - d. Signs in system shall be convertible in the field to allow for enlargement from one size to another in height and width through use of Joiners or Accent Joiners, which connect Rail Back panels together blindly, providing a butt joint between Copy Panels. Accent Joiners shall connect Rail Backs together with a visible 3 mm (1/8") horizontal rib, flush to the adjacent copy insert surfaces.
  - e. Sign configurations shall vary in width from 225 mm (9 inches) to 2050 mm (80 inches), and have height dimensions of 50 mm (2 inches), 75 mm (3 inches), 150 mm (6 inches), 225 mm (9 inches) and 300 mm (12 inches). Height shall be increased beyond 300 mm (12 inches), by repeating height module in full or in part.
3. Rail Back functions as internal structural member of sign using 6063T5 extruded aluminum and anodized black.
- a. Shall accept an extruded aluminum or plastic insert on one sign or on both sides, depending upon sign type.
  - b. Shall be convertible in field to allow for connection to other Rail Back panels, so that additive changes can be made to sign unit.

- c. Rail shall allow for a variety of mounting devices including wall mounting for screw-on applications, using pressure sensitive tape, freestanding mount, ceiling mount and other mounting devices as needed.
- 4. Rail Insert functions as a mounting device for Copy Panels on to the Rail Back. The Rail Insert mounts to the back of the Copy Panel with adhesive suitable for use with the particular copy insert material.
  - a. Shall allow Copy Panels to slide or snap into the horizontal Rail Back for ease of changeability.
  - b. Shall mount to the back of the Copy Panel with adhesive suitable for use with particular Copy Panel material.
- 5. Copy Panels shall accept various forms of copy and graphics, and attaches to the Rail Back with the Rail Insert. Copy Panels shall be either ABS plastic with integral color or an acrylic lacquer finish; photo polymer; or, acrylic.
  - a. Interchangeable by sliding horizontally from either side of sign, and to other signs in system of equal or greater width or height.
  - b. Cleanable without use of special chemicals or cleaning solutions.
  - c. Copy Insert Materials.
    - 1) ABS Inserts - 2.3 mm (.090 inches) extruded ABS plastic core with .07 mm (.003 inches) acrylic cap bonded during extrusion/texturing process. Pressure bonded to extruded Rail Insert using adhesive. Background color is either integral or painted in acrylic lacquer. ABS inserts finished in a chromium industries #HM335RA texture pattern to prevent glare.
    - 2) Photo polymer Inserts - 3 mm (.125 inches) phenolic photo polymer with raised copy etched to 2.3 mm (.0937 inches), bonded to an ABS plastic or extruded aluminum insert with adhesive. Background color is painted in acrylic enamel.
    - 3) Changeable Paper/ Insert Holder - Extruded insert holder with integral Rail Insert for connection with structural back panel in 6063T5 aluminum with a black anodized finish. Inserts into holder are paper with a clear 0.7 mm (.030 inches) textured cover. Background color is painted in acrylic lacquer.
    - 4) Acrylic - 2 mm (.080 inches) non-glare acrylic. Pressure bonded to extruded Rail Insert using adhesive. Background color is painted in acrylic lacquer or acrylic enamel.
    - 5) Extruded 6063T5 aluminum with a black anodized finish Insert Holder with integral Rail Insert for connection with Structural Back Panel to hold a 0.7 mm (.030 inches) textured

polycarbonate insert and a Sliding Tile which mounts in the Inset Holder and slides horizontally.

- 6) End Caps - Extruded using 6063T5 aluminum with a black anodized. End Caps interlock with Rail Back with clips to form an integral unit, enclosing and securing the changeable Copy Panels, without requiring tools for assembly.
  - a) Shall be interchangeable to either end of sign and to other signs in the system of equal height.
  - b) Mechanical fasteners can be added to the End Caps that will secure it to Rail Back to make sign tamper resistant.
- 7) Joiners - Extruded using 6063T5 aluminum with a black anodized finish. Rail Joiners connect Rail Backs together blindly, providing a butt joint between Copy Inserts.
- 8) Accent Joiners - Extruded using 6063T5 aluminum with a mirror polished finish. Joiner shall connect Rail Backs together with a visible 3 mm (.125 inches) horizontal rib, flush to the adjacent Copy Panel surfaces.
- 9) Top Accent Rail - Extruded using 6063T5 aluminum with a mirror polished finish. Rail shall provide 3 mm (.125 inches) high decorative trim cap, which butts flush to adjacent Copy Panel and encloses top of Rail Back and Copy Panel.
- 10) Typography
  - a) Vinyl First Surface Copy (non-tactile) - Applied Vinyl copy.
  - b) Subsurface Copy Inserts - Textured 1 mm (.030 inches) clear polycarbonate face with subsurface applied Vinyl copy. Face shall be back sprayed with paint and laminated to an extruded aluminum carrier insert.
  - c) Integral Tactile Copy Inserts - phenolic photo polymer etched with 2.3 mm (.0937 inches) raised copy.
  - d) Silk-screened First Surface Copy (non-tactile) - Injection molded or extruded ABS plastic or aluminum insert with first surface applied enamel silk-screened copy.

F. Sign Type I:

1. Takeform Type I F20B-G1, 9.5"w x 10.5"h, front thumb notch, accommodates insert. Face finish: LS837 Graphite, Backer finish: 3form (specific style to be determined by the VA as a coordinating finish to the interiors), Raised copy: C0104 White, Font: Helvetica Neue, Insert: Media White paper, copy: Helvetica Neue-Black, Image: (specific shutterstock image to be determined by VA to coordinate with the finish of the interiors).

I. Temporary Interior Signs:



1. Fabricated from 50 kg (110 pound) matte finished white paper cut to 100 mm (4 inch) wide by 300 mm (12 inch) long. Punched 3 mm (.125 inch) hole with edge of hole spaced 13 mm (.5 inch) in from edge and centered on 100 mm (4 inch) side. Reinforce hole on both sides with suitable material that prevents tie from pulling through hole. Ties are steel wire 0.3 mm (0.120 inch) thick attached to tag with twist leaving 150 mm (6 inch) long free ends.
2. Mark architectural room number on sign, with broad felt marker in clearly legible numbers or letters that identify room, corridor or space as shown on floor plans.
3. Install temporary signs to all rooms that have a room, corridor or space number. Attach to door frame, door knob or door pull.
  - a. Doors that do not require signs are: corridor doors in corridor with same number, folding doors or partitions, toilet doors, bathroom doors within and between rooms, closet doors within rooms, communicating doors in partitions between rooms with corridor entrance doors.
  - b. Replace and missing damaged or illegible signs.

## **2.5 FABRICATION**

- A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
- B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.
- D. Contact surfaces of connected members be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth surfaces.
- G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.

- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
- I. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Edge joints tightly mitered to give appearance of solid material.
- J. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
- K. Movable parts, including hardware, are to be cleaned and adjusted to operate as designed without binding or deformation of members. Doors and covers centered in opening or frame. All contact surfaces fit tight and even without forcing or warping components.
- L. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
- M. No signs are to be manufactured until final sign message schedule and location review has been completed by the Resident Engineer & forwarded to contractor.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.
- B. Mount signs in proper alignment, level and plumb according to the sign location plan and the dimensions given on elevation and sign location drawings. Where otherwise not dimensioned, signs shall be installed where best suited to provide a consistent appearance throughout the project. When exact position, angle, height or location is in doubt, contact Resident Engineer for clarification.
- C. Contractor shall be responsible for all signs that are damaged, lost or stolen while materials are on the job site and up until the completion and final acceptance of the job.
- D. Remove or correct signs or installation work COR determines as unsafe or as an unsafe condition.

- E. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.
- F. Locate signs as shown on the Sign Location Plans.
- G. Certain signs may be installed on glass. A blank glass back up is required to be placed on opposite side of glass exactly behind sign being installed. This blank glass back up is to be the same size as sign being installed.
- H. Contractor will be responsible for verifying that behind each sign location there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.
- I. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.

- - - END - - -

**SECTION 10 26 00**  
**WALL AND DOOR PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies wall guards (crash rails or bumper guards), handrail/wall guard combinations, corner guards and door/door frame protectors and high impact wall covering.

**1.2 RELATED WORK**

- A. Armor plates and kick plates not specified in this section: Section 08 71 00 - DOOR HARDWARE.
- B. Color and texture of aluminum and resilient material: in finish schedule on drawings.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Shop Drawings: Show design and installation details.
- C. Manufacturer's Literature and Data:
  - 1. Handrail/Wall Guard Combinations.
  - 2. Wall Guards.
  - 3. Corner Guards.
  - 4. Door/Door Frame Protectors.
  - 5. High Impact Wall covering
- D. Test Report: Showing that resilient material complies with specified fire and safety code requirements.

**1.4 DELIVERY AND STORAGE**

- A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer.
- B. Protect from damage from handling and construction operations before, during and after installation.
- C. Store in a dry environment of approximately 21° C (70 degrees F) for at least 48 hours prior to installation.

**1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

- B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods,  
Wire, Shapes, and Tubes
- D256-06.....Impact Resistance of Plastics
- D635-06.....Rate of Burning and/or Extent and Time of  
Burning of Self-Supporting Plastics in a  
Horizontal Position
- E84-09.....Surface Burning Characteristics of Building  
Materials
- C. The National Association of Architectural Metal Manufacturers (NAAMM):  
AMP 500-06.....Metal Finishes Manual
- D. National Fire Protection Association (NFPA):  
80-10.....Standard for Fire Doors and Windows
- E. Society of American Automotive Engineers (SAE):  
J 1545-05.....Instrumental Color Difference Measurement for  
Exterior Finishes.
- F. Underwriters Laboratories Inc. (UL):  
Annual Issue.....Building Materials Directory

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Stainless Steel: ASTM A167, Type 302B.
- B. Aluminum Extruded: ASTM B221, Alloy 6063, Temper T5 or T6.
- C. Resilient Material:
1. Extruded and injection molded acrylic vinyl or extruded polyvinyl chloride meeting following requirements:
    - a. Minimum impact resistance of 1197 ps (25 ft lbs per sq.ft) when tested in accordance with ASTM D256 (Izod impact, ft.lbs. per inch notch).
    - b. Class 1 fire rating when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less.
    - c. Rated self extinguishing when tested in accordance with ASTM D635.
    - d. Material shall be labeled and tested by Underwriters Laboratories or other approved independent testing laboratory.
    - e. Integral color with all colored components matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.
    - f. Same finish on exposed surfaces.

### **2.2 CORNER GUARDS**

- A. As shown on finish schedule on drawings.

## **2.3 WALL GUARDS AND HANDRAILS**

### **A. Resilient Wall Guards and Handrails:**

1. Handrail/Wall Guard Combination: Snap-on covers of resilient material, minimum 2 mm (0.078-inch) thick, shall be free-floated on a continuous, extruded aluminum retainer, minimum 1.8 mm (0.072-inch) thick, anchored to wall at maximum 760 mm (30 inches) on center.
2. Wall Guards (Crash Rails): Snap-on covers of resilient material, minimum 2.8 mm (0.110-inch) thick, shall be free-floated over 50 mm (two-inch) wide aluminum retainer clips, minimum 2.3 mm (0.090-inch) thick, anchored to wall at maximum 600 mm (24 inches) on center, supporting a continuous aluminum retainer, minimum 1.6 mm (0.062-inch) thick; or, shall be free-floated over a continuous extruded aluminum retainer, minimum 2.3 (0.090-inch) thick anchored to wall at maximum 600 mm (24 inches) on center.
3. Provide handrails and wall guards (crash rails) with prefabricated and closure caps, inside and outside corners, concealed splices, cushions, mounting hardware and other accessories as required. End caps and corners shall be field adjustable to assure close alignment with handrails and wall guards (crash rails). Screw or bolt closure caps to aluminum retainer.

### **B. Aluminum Wall Guards: Extruded aluminum, closed tubular bumper assembly mounted on wall brackets as shown.**

1. Provide wall bumper with factory fabricated end closure caps, and inside and outside corner assemblies, concealed splice plates, and other accessories standard with the manufacturer.
2. Fabricate tubular wall guards from material with a nominal wall thickness of 6 mm (0.250-inch), form grooves for and provide two strips of continuous polyvinyl chloride cushion bumper inserts.
3. Fabricate adjustable wall brackets from aluminum having a nominal wall thickness of 5 mm (0.20-inch). Fasten bumper to brackets with 6 mm (1/4-inch) diameter aluminum or stainless steel bolts with locknuts.

## **2.4 DOOR AND DOOR FRAME PROTECTION**

- A. Fabricate door and door frame protection items from vinyl acrylic or polyvinyl chloride resilient material, minimum 1.5 mm (0.060-inch) thick, for doors and 0.9 mm (0.035-inch) thick for door frames, as shown.
- B. Coordinate door and door frame protection material requirements with door and frame suppliers to insure fit for all components, and color as specified.

C. Provide adhesive as recommended by resilient material manufacturer.

## **2.5 HIGH IMPACT WALL COVERING**

- A. Fabricate from vinyl acrylic or polyvinyl chloride resilient material minimum 6mm (0.06 inch) thick designed specially for interior use.
- B. Coordinate with door protection material and supplier for proper fit, installation and color.
- C. Provide adhesive as recommended by the wall covering manufacturer.

## **2.6 FASTENERS AND ANCHORS**

- A. Provide fasteners and anchors as required for each specific type of installation.
- B. Where type, size, spacing or method of fastening is not shown or specified, submit shop drawings showing proposed installation details.

## **2.7 FINISH**

- A. In accordance with NAAMM AMP 500 series.
- B. Aluminum:
  - 1. Exposed aluminum: AAC22A31
  - 2. Concealed aluminum: Mill finish as fabricated, uniform in color and free from surface blemishes.
- C. Stainless Steel: NAAMM finish Number 4.
- D. Resilient Material: Embossed texture and color in accordance with SAE J 1545 and as specified in finish schedule on drawings.

## **PART 3 - INSTALLATION**

### **3.1 STAINLESS STEEL CORNER GUARDS**

- A. Mount guards on external corners of interior walls, partitions and columns as shown.
- B. Where corner guards are installed on walls, partitions or columns finished with plaster or ceramic tile, Provide continuous 16 gage perforated, galvanized Z-shape steel anchors welded to back edges of corner guards and expansion bolted to concrete or masonry with four 9.5 mm (3/8-inch) diameter bolts, spaced 400 mm (16 inches) on centers. Coat back surfaces of corner guards, where shown, with a non-flammable, sound deadening material. Corner guards shall overlap finish plaster surfaces.
  - 1. Where corner guards are installed on exposed structural glazed facing tile units or masonry wall, partitions or columns, anchor corner guards to existing walls with 6 mm (1/4-inch) oval head stainless steel countersunk expansion or toggle bolts. Grout spaces solid between guards and backing with Portland cement and sand mortar.
  - 2. Where corner guards are installed on gypsum board, clean surface and anchor guards with a neoprene solvent-type contact adhesive

specifically manufactured for use on gypsum board construction.

Remove excess adhesive from around edge of guard and allow to cure undisturbed for 24 hours.

**3.3 RESILIENT HANDRAIL WALL GUARD COMBINATIONS AND RESILIENT WALL GUARDS (CRASH RAIL)**

Secure guards to walls with mounting cushions, brackets and fasteners in accordance with manufacturer's details and instructions.

**3.4 ALUMINUM WALL GUARDS**

Secure brackets to walls with fasteners, spaced in accordance with manufacturer's installation instructions.

**3.5 STAINLESS STEEL WALL GUARDS**

Space brackets at not more than three feet on centers and anchor to the wall in accordance with manufacturer's installation instructions.

**3.6 DOOR, DOOR FRAME PROTECTION AND HIGH IMPACT WALL COVERING**

- A. Surfaces to receive protection shall be clean, smooth and free of obstructions.
- B. Install protectors after frames are in place but preceding installation of doors in accordance with approved shop drawings and manufacturers specific instructions.
- C. Apply with adhesive in controlled environment according to manufacture's recommendations.
- D. Protection installed on fire rated doors and frames shall be installed according to NFPA 80 and installation procedures listed in UL Building Materials Directory; or, equal listing by other approved independent testing laboratory establishing the procedures.

- - - E N D - - -



**SECTION 10 44 13**  
**FIRE EXTINGUISHER CABINETS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section covers semi-recessed fire extinguisher cabinets.

**1.2 RELATED WORK**

- A. Acrylic glazing: Section 08 80 00, GLAZING.
- B. Field Painting: Section 09 91 00, PAINTING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Fire extinguisher cabinet including installation instruction and rough opening required.

**1.4 APPLICATION PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Testing and Materials (ASTM):  
D4802-10.....Poly (Methyl Methacrylate) Acrylic Plastic Sheet

**PART 2 - PRODUCTS**

**2.1 FIRE EXTINGUISHER CABINET**

Semi-Recessed type with 2 ½ inch rolled edge.

**2.2 FABRICATION**

- A. Form body of cabinet from 0.9 mm (0.0359 inch) thick sheet steel.
- B. Fabricate door and trim from 1.2 mm (0.0478 inch) thick sheet steel with all face joints fully welded and ground smooth.
  - 1. Glaze doors with 6 mm (1/4 inch) thick ASTM D4802, clear acrylic sheet, Category B-1, Finish 1.
  - 2. Design doors to open 180 degrees.
  - 3. Provide continuous hinge, pull handle, and adjustable roller catch.

**2.3 FINISH**

- A. Finish interior of cabinet body with baked-on semigloss white enamel.
- B. Finish door, frame with manufacturer's standard baked-on prime coat suitable for field painting.

**PART 3 - EXECUTION**

- A. Install fire extinguisher cabinets in prepared openings and secure in accordance with manufacturer's instructions.
- B. Install bottom of cabinet at 975 mm (39 inches) above finished floor.

PROJECT NO. 618-CSI-100  
Renovate to Create Hybrid OR, Phase 2  
100% CD Issue  
03-30-2015

- - - E N D - - -

**SECTION 11 42 00**  
**OPERATING ROOM SERVICE BOOMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTIONS**

This section specifies ceiling-mounted service booms for operating room equipment and services.

**1.3 RELATED WORK**

- A. Section 05 50 00 METAL FABRICATIONS
- B. Section 22 05 11 COMMON WORK RESULTS FOR PLUMBING
- C. Section 22 62 00 VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES
- D. Section 22 63 00 GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES
- E. Division 26 ELECTRICAL
- F. Division 27 COMMUNICATIONS

**1.5 QUALITY CONTROL**

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC: Quality Assurance 1.3.D - Products Criteria.
- B. Mechanical, electrical, and associated systems shall be safe, reliable, efficient, durable, easily and safely operable, maintainable, and accessible.
- C. Standard Products: Material and equipment shall be the standard products of the selected manufacturer, and they should be regularly engaged in the manufacture of such products for at least 3 years. The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work stations, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
- D. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
- F. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

- G. Installer Qualifications: Installer is authorized representative of sterilizer manufacturer and employs factory-trained personnel to install sterilizers. Installer is licensed as may be necessary by regulatory organizations.

#### **1.6 SUBMITTALS**

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Include the following:
1. Illustrations and descriptions of medical reprocessing equipment.
  2. Optional auxiliary equipment and controls.
  3. Catalog or model numbers for each component.
  4. Utility requirements.
- C. Shop Drawings: Show details of fabrication, installation, adjoining construction, coordination with mechanical and electrical work, anchorage, and other work required for complete installation.
- D. Field Test Reports: Provide certification reports from accredited service technicians or installers.
- E. Operating Instructions: Comply with requirements in specification Section 01 00 00, GENERAL REQUIREMENTS.

### **PART 2 - PRODUCTS**

#### **2.1 OPERATING ROOM SERVICE BOOMS**

- A. Booms, lights, and integration systems furnished by Skytron as shown on attached document.
- B. Welded tube mounting structures shall be furnished by Skytron, installed by Contractor.
- C. Additional structural steel support as shown on drawings shall be furnished and installed by Contractor.
- D. Rough-in for all items indicated on attached Skytron document, including conduit, wall boxes, electrical circuits/wiring, network drops, med gas riser plates, and med gas piping shall be provided by Contractor.
- E. Wall controls for surgical lights shall be furnished by Skytron and installed by Contractor.
- F. Final connections for all electrical and medical gas supplies shall be provided by Contractor.
- G. Transport of equipment crates from receiving area to installation area shall be provided by Contractor.

**PART 3 - EXECUTION**

**3.1 OPERATING ROOM SERVICE BOOMS**

A. As shown on attached Skytron document.

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**Skytron Response To Request For Quotation From**



**VISN 23 - Minneapolis - Philips Hybrid OR**

**PRESENTED BY:**  
**Pete Jaenchen - Principal**



**January 12, 2015**

January 12, 2015

VA Midwest Health Care Network VISN 23  
5445 Minnehaha Ave S  
Minneapolis MN 55417

Mr. Mike Phelps  
Director BIS

Mike,

Here are revised quotations for the Philips room and the Siemens room. The following revisions have been made since the prior revision of these quotes:

1. Smoke Evacuation systems have been removed from all Skybooms.
2. Added one (1) WAGD outlet to the Anesthesia booms in both rooms; there are now two (2) each WAGD outlets instead of one.
3. Boom E (Siemens room); Equipment carrier changed back to the wider 22" width.
4. Radiation Shields in both Hybrid ORs will match the Mavig Radiation Shield that was furnished for the EP/TAVR room.
5. Added two (2) each red electrical duplex outlets to each Perfusion boom, for a total of eight (8) instead of six (6).
6. iPod and Audio Integration components have been added to the SkyVision Linx300 Integration Systems in both Hybrid rooms.

This completes all of the revisions and these quotes are ready to forward to your contracting staff. Normally our CAD team will begin work on the complete set of Submittal Drawings upon receipt of the PO (or DO), however I will request that they begin work on those as soon as possible. I do know that the jobs with purchase orders in house take precedence over projects that have not been ordered, so I would recommend that you still try to have contracting complete their work as soon as possible.

Please let me know if you have any questions. I appreciate the opportunity to work with all of you and to be of service to our Veterans!

Best Regards,,



Pete Jaenchen  
Principal  
Jaenchen Medical Resources

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**Summary** - presented January 12, 2015

**Quote:**48567 - 2

**Date:**04/25/2014

**Expires:**04/30/2015

**Sales Rep:**Pete Jaenchen

**Email:**[pete@jaenchenmedical.com](mailto:pete@jaenchenmedical.com)

**Phone:**612 802-0447

Jaenchen Medical Resources

2515 Bobolink Rd.

Long Lake MN 55356

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**Facility:**VA Midwest Health Care Network VISN 23  
5445 Minnehaha Ave S  
Minneapolis MN 55417

**Attn:**Mr. Mike Phelps, Director BIS

**GPO:**VISN 23 - V A Upper Midwest Health Care Network Tier 1  
FSS - Department of Veterans Affairs Tier 1

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We are pleased to quote the following Skytron Products for your review.

Boom A - Equipment Carrier / Anesthesia  
Boom Cc - Extended Arm LED Light (camera)  
Boom C - Extended Arm LED Light  
Boom D - Large Display  
Boom E - Utility Carrier / Small Display  
Boom F - Radiation Shield  
Boom G - Large Display (Philips) / Perfusion  
HD In-Light Camera System  
SkyVision & Displays  
Equipment Total  
Installation  
Handling

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**Terms and Conditions**

**Terms** 0.5% 10 days, Net 30 days  
Shipping and Taxes are not included in this quote unless itemized above.

**Warranty** 1 year parts and labor on equipment  
90 days on replacement parts, supplies, spare bulbs (for surgical lights), pads (for surgical tables) and accessory items  
15 years on sterilizer pressure vessel (steam chamber and jacket)

**FOB** Destination, prepaid and absorbed to 48 states & Point of Exit to Alaska, Hawaii, and Puerto Rico with overseas freight paid by the government  
All shipments subject to handling charge

**Delivery** 45 to 120 days after receipt of order

**Deposit** 25% deposit required for non-contracted products upon order acceptance  
50% deposit required for SkyVision, VACS and Custom products upon order acceptance

**Contract Code** (FSS BPA V797P-4098b)

**Issue PO To** Skytron, LLC | PO Box 888615, Grand Rapids, MI 49588-8615 | 616-656-2900 \* Please include the entire quote number on your P.O.

**Submit PO To** Email to [orders@skytron.us](mailto:orders@skytron.us) or fax to 616-656-2906



**Remit To**

Skytron, LLC | 16208 Collections Center Drive, Chicago, IL 60693 | 616-656-2900

**Acknowledgement**

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Title: \_\_\_\_\_

## Boom A - Equipment Carrier / Anesthesia

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-G	Pre-Installation Kit for up to 12 gas inlet tubes, includes mounting plate, required for any boom that will accommodate gases
1	1	ETM2F_/2F_	Tandem system with two arm sets on one hub. Fixed height upper arm set (61"/31.5"), fixed height lower arm set (48"/31.5")
1	1	PM48	48" Center-aligned carrier with front shelf supports, 36 outlets, 22" wide, does not include shelves
1	1	H8-200-58	Height Adjustable Flatscreen monitor mount for VST
1	1	H8-010-50-1	Downpost Kit for GCX variable height arm
1	1	H8-300-14	Foot pedal holder 22"W CM, PM, VBM carriers 50 lb weight capacity (Requires PMSH shelf on CM & VBM carriers)
2	2	H8-300-31	Vacuum Slide Premium (PM,KM,XM) carrier bolt on / Not for use on VBM or CM carriers
1	1	H8-300-11	Back cover, 48", hinged
1	1	H8-300-23	CO2 bottle holder, holds 2 E size cylinders
3	3	PMSH	22" Shelf for PM, VBM, CM carriers, includes mounting hardware
1	1	H8-300-17-1	Base utility box, 22", Nitrogen system cutout on right side, required for SkyVac
1	1	H6-305-16_	Nitrogen control system, DISS single outlet, horizontal
2	2	H6-372-01-_	Oxygen outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-03-_	Medical air outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-04-_	Vacuum outlet - OHMEDA (BeaconMedaes standard, others available upon request)
6	6	H7-300-01	Electrical receptacle, duplex, 20A, red, w/ faceplate
2	2	H7-300-03	Electrical receptacle, duplex, 20A, white, w/ faceplate requires H7-300-XX-1 for electrical separation
2	2	H7-300-XX-1	UPGRADE, electrical receptacle mount in base utility box (additional per outlet) +
1	1	H7-310-07	Cable faceplate, stainless, with 2" grommet
1	1	VBM36	36" Vertical Utility Box, 28 outlets, does not include cantilevered shelves, accepts any width shelf
2	2	H8-300-30	Vacuum Slide mounted in carrier rear channel / For use on PM,CM, XM,KM,VBM carriers
2	2	H6-372-01-_	Oxygen outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-02-_	Nitrous oxide outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-03-_	Medical air outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-04-_	Vacuum outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-09-_	WAGD outlet - OHMEDA (BeaconMedaes standard, others available upon request)
6	6	H7-300-01	Electrical receptacle, duplex, 20A, red, w/ faceplate
2	2	H7-300-03	Electrical receptacle, duplex, 20A, white, w/ faceplate requires H7-300-XX-1 for electrical separation
2	2	H7-300-XX-1	UPGRADE, electrical receptacle mount in base utility box (additional per outlet) +

1	1	H2-200-02-C9.5	Extended ceiling cover ring for a total clearance of 12" from top of arm to finished ceiling. Works with two piece rotating cover style only.
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

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**Boom A - Equipment Carrier / Anesthesia Total**

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<http://www.skytron.us/products/pages/booms.html>

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## Boom Cc - Extended Arm LED Light (camera)

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
5445 Minnehaha Ave S  
Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	AUT5TVC-2000	Single 24" Aurora 3 camera ready light on 78.75" radial arm. Includes 65 ft. of video cable, wall faceplate, counterweight and sterilizable sleeve
1	1	B9-715-03	Triple wall intensity control for Aurora 3 AUT series only
1	1	B9-410-44-1	Wall Control Back Box; Aurora, Stellar & Nautilus Series (triple only).
1	1	B9-210-44-3	Special EXTENDED ceiling covers for Aurora, Stellar & Nautilus over 10"

**Boom Cc - Extended Arm LED Light (camera) Total**



<http://www.skytron.us/products/pages/lights.html>

## Boom C - Extended Arm LED Light

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
5445 Minnehaha Ave S  
Minneapolis MN 55417

Group Qty: 2

		Ext	Item	Description
Qty	Qty	Qty	Number	
1	2		AUT5C-2000	Single 24" Aurora 3 center focus light on 78.75" radial arm t with 110 degree vertical travel
1	2		B9-210-44-3	Special EXTENDED ceiling covers for Aurora, Stellar & Nautilus over 10"

**Boom C - Extended Arm LED Light Total**



<http://www.skytron.us/products/pages/lights.html>

## Boom D - Large Display

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-NG	Pre-Installation Kit, includes mounting plate, required for flatscreen or flatscreen with lights only
1	1	EC2E_/NL	Central mount with dual arm system, powered height on one hub without lights (61" upper, 31.5" lower)
1	1	FCM-PHILIPS	Philips Large Screen Adapter 2E Only
1	1	H2-200-02-C9.5	Extended ceiling cover ring for a total clearance of 12" from top of arm to finished ceiling. Works with two piece rotating cover style only.
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

### Boom D - Large Display Total



<http://www.skytron.us/products/pages/booms.html>

## Boom E - Utility Carrier / Small Display

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-G	Pre-Installation Kit for up to 12 gas inlet tubes, includes mounting plate, required for any boom that will accommodate gases
1	1	ET2F_/2AF_	Tandem system with two arm sets on one hub. Fixed height upper arm set (61"/31.5"), lower arm set for flatscreen mount (51"/35.5"), flatscreen mounting bracket required (priced separately). Requires flatscreen power cord(s) (priced separately)
1	1	PM48	48" Center-aligned carrier with front shelf supports, 36 outlets, 22" wide, does not include shelves
3	3	PMSH	22" Shelf for PM, VBM, CM carriers, includes mounting hardware
2	2	H6-372-01-_	Oxygen outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-02-_	Nitrous oxide outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-03-_	Medical air outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-04-_	Vacuum outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-09-_	WAGD outlet - OHMEDA (BeaconMedaes standard, others available upon request)
6	6	H7-300-01	Electrical receptacle, duplex, 20A, red, w/ faceplate
2	2	H7-300-03	Electrical receptacle, duplex, 20A, white, w/ faceplate requires H7-300-XX-1 for electrical separation
1	1	FC1	Flatscreen Bracket, single monitor mount, 26" max. screen size
1	1	FC1-26	Fc1 Handles Up To 26.5" Wide Requires Fc1
1	1	H2-200-02-C9.5	Extended ceiling cover ring for a total clearance of 12" from top of arm to finished ceiling. Works with two piece rotating cover style only.
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

### Boom E - Utility Carrier / Small Display Total



<http://www.skytron.us/products/pages/booms.html>

## Boom F - Radiation Shield

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-NG	Pre-Installation Kit, includes mounting plate, required for flatscreen or flatscreen with lights only
1	1	LC2ALF_/NL	Lightweight mount with dual arm system on one hub without surgical lights (59" upper, 35.5" lower) for flatscreen mount, flatscreen mounting bracket required (priced separately). Requires flatscreen power cord(s) (priced separately)
1	1	X-RAY 50010	MAVIG X-Ray Shield 61x76 cm center mounted with cutout and lead panels. AFC arms only
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

**Boom F - Radiation Shield Total**



<http://www.skytron.us/products/pages/booms.html>



## Boom G - Large Display (Philips) / Perfusion

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-G	Pre-Installation Kit for up to 12 gas inlet tubes, includes mounting plate, required for any boom that will accommodate gases
1	1	ETM2E_/2F_	Tandem system with two arm sets on one hub. Powered height upper arm set (61"/31.5"), fixed height lower arm set (48"/31.5")
1	1	FCM-PHILIPS	Philips Large Screen Adapter 2E Only
1	1	VBM48	48" Vertical Utility Box, 36 outlets, does not include cantilevered shelves, accepts any width shelf
1	1	H8-200-58	Height Adjustable Flatscreen monitor mount for VST
1	1	H8-010-50-1	Downpost Kit for GCX variable height arm
1	1	H8-300-23	CO2 bottle holder, holds 2 E size cylinders
2	2	H8-300-30	Vacuum Slide mounted in carrier rear channel / For use on PM,CM, XM,KM,VBM carriers
2	2	H6-372-01-_	Oxygen outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-03-_	Medical air outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-04-_	Vacuum outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-09-_	WAGD outlet - OHMEDA (BeaconMedaes standard, others available upon request)
8	8	H7-300-01	Electrical receptacle, duplex, 20A, red, w/ faceplate
2	2	H7-300-03	Electrical receptacle, duplex, 20A, white, w/ faceplate requires H7-300-XX-1 for electrical separation
2	2	H7-300-XX-1	UPGRADE, electrical receptacle mount in base utility box (additional per outlet) +
1	1	H2-200-02-C9.5	Extended ceiling cover ring for a total clearance of 12" from top of arm to finished ceiling. Works with two piece rotating cover style only.
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

### Boom G - Large Display (Philips) / Perfusion Total



<http://www.skytron.us/products/pages/booms.html>

## HD In-Light Camera System

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
5445 Minnehaha Ave S  
Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	TV-3-AUT	Precision HD camera system for AUT series lights
			<b>HD In-Light Camera System Total</b>

## SkyVision & Displays

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	SVIS-LINX	SkyVision LINX 300 Digital Integration system includes: Medical Grade Touch Panel, Optical Router, IP addressable Control Switch and On-Board Uninterruptable Power Supply.
1	1	SVIS-SECTP	SkyVision LINX 300 Secondary Touch Panel
15	15	SVIS-SOURCE	SkyVision LINX 300 Source Cable Kit includes: 100ft Fiber Optic Cable, DC Power Cable, Faceplate Converter, and 15ft Native Source Cable
12	12	SVIS-DISPLAY	SkyVision LINX 300 Display Cable Kit includes: 100ft Fiber Optic Cable, 100 ft DC Power Cable, DVI Extender Receiver, and Medical Grade Power Supply
1	1	SVIS-12ROUTABLE	SkyVision LINX 300 Extended Routable Displays (up to 4 extra)
1	1	SVIS-AUD	SkyVision LINX 300 Premium Audio Package
1	1	SVIS-POD	SkyVision LINX 300 IPOD Docking Station
3	3	MON-026-LED	FSN HD-Zoom 26" Medical Grade LED Display for surgical and PACS imaging. 1920 X 1080 resolution includes 24VDC power supply, Inputs: DVI, VGA, SDI, Composite, SOG, S-Video, Component, RS-232. Includes Image Zoom compatibility via SkyVision Touch Panel or front panel buttons on the display. Display includes a built-in cable cover.
3	3	MON-CBL-001	Cable Kit - Allows FSN monitor power supply to be up to 75' from the monitor. For FSN 24" and 26" displays only.

**SkyVision & Displays Total**

## Installation

**Quote:** 48567 - 2

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
5445 Minnehaha Ave S  
Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
3	3	Installation-D	Installation Tandem Mount Systems, includes carrier/carrier and carrier/flatscreen, for models requiring special adapters please include P3-510-06.
2	2	Installation-D	Installation, Single & Dual Arm Systems
3	3	Installation-D	Installation of Aurora, Stellar, Infinity, Millennium and Nautilus
1	1	Installation-D	Addition of TV Function
1	1	Installation-D	Complete Installation, Testing and System Certification for LINX 300 or Hybrid II Digital Series SkyVision; per room.
1	1	Installation-D	Go-Live Support.
			<b>Installation Total</b>

## Supplemental Terms and Conditions

**Drawing Change Fee.**

\$200.00 drawing change fee will be invoiced after 2nd drawing revision.

**Change Order Fee.**

Change order fees, equal to five percent (5%) of order total, apply if order changes occur within 60 days prior to shipment.

**Cancellation Fee.**

Eight percent (8%) cancellation fee will be invoiced or deposit will be forfeited on cancelled items of an equipment order.

**Minimum Order Fee.**

Orders with a product total less than \$25.00 are subject to a \$20 non-refundable minimum order fee added to the invoice.

**Re-Stocking Fee.**

- a. Equipment - 20% re-stocking fee will apply to all returns for credit. Refurbishment charges, if any, will be calculated upon inspection of the goods when received. All returns to be authorized by Skytron in advance.
- b. Parts - \$50.00 re-stocking fee for inspection/testing, plus up to five percent (5%) of item cost for repair/refurbishing charge (not to exceed \$2,500 per item). Non-warranty part returns with a List Price less than \$100.00 per item will not be accepted.
- c. Re-Stocking policy does not supersede Skytron's North American Warranty policy, Demo policy, or Table Pad Return policy.

**Cable Installation.**

Pricing is inclusive of the installation of up to 15 communication cables provided by the minimally invasive surgery equipment supplier at the time of the installation of Skytron product. Additional cables can be installed for a price of \$100.00 each. Please verify number of cables for accurate pricing. Skytron SkyVision systems are exempt.

**Final Adjustments.**

Final adjustments included in all installation pricing.

**Miscellaneous.**

- a. Unless otherwise noted, Skytron reserves the right to make product improvements, discontinue products, and change prices without notice.
- b. Orders are subject to credit approval.
- c. Unless otherwise noted or previously negotiated, quoted amounts Do Not Include freight costs and applicable taxes. Freight and tax rates in effect at time of shipment will be applied.
- d. Buyer expressly agrees that no terms and conditions shall supersede those in this quote without express, written consent of Skytron.

## Service Terms and Conditions

### **Working Hours.**

All service and installation pricing is based on normal working hours, 8 AM to 5 PM, Monday thru Friday, excluding holidays.

### **Disconnection and Removal of Existing Equipment.**

If required, for a fee, Skytron can disconnect and remove existing equipment.

### **Union Labor.**

Facilities requiring the use of union labor must be identified as such for quoting purposes.

### **Seismic Requirements.**

Please notify Skytron's Service Manager for installations having specific seismic requirements. Skytron is not responsible for any x-raying of the floor, structural ceiling through bolting, and associated fasteners.

### **Trade-in Equipment.**

Please notify Skytron's Service Manager for installation where trade-in equipment will be present.

### **Combination Products.**

For integrated products combining lighting and equipment pendants, include installation pricing for both individual units.

### **Scheduling.**

Contact Skytron's Service Manager a minimum of 15 working days prior to desired installation date. Large and intensive projects requiring multiple phases require a minimum 60-day notice before installation commences. Please contact Skytron's National Service Manager or Sales Representative.

### **Service Contracts.**

A signed service contract is required. A preliminary evaluation of product may be required for product that has been in use for some time.

### **Electrical Connections, Final Tie-Ins and Finishes.**

All final tie-ins of electrical connections, plumbing and media must be made by a qualified and licensed individual. Skytron does not provide final tie-in services due to local licensing regulations. Finish work (e.g., caulking and trim) is the responsibility of others. Installation of standard product moldings or trim is included in the pricing provided.

**Skytron Response To Request For Quotation From**



**VA Midwest Health Care Network VISN 23**

**VISN 23 - Minneapolis - Siemens Hybrid OR**

**PRESENTED BY:**  
**Pete Jaenchen - Principal**



**January 12, 2015**



January 12, 2015

VA Midwest Health Care Network VISN 23  
5445 Minnehaha Ave S  
Minneapolis MN 55417

Mr. Mike Phelps  
Director BIS

Mike,

Here are revised quotations for the Philips room and the Siemens room. The following revisions have been made since the prior revision of these quotes:

1. Smoke Evacuation systems have been removed from all Skybooms.
2. Added one (1) WAGD outlet to the Anesthesia booms in both rooms; there are now two (2) each WAGD outlets instead of one.
3. Boom E (Siemens room); Equipment carrier changed back to the wider 22" width.
4. Radiation Shields in both Hybrid ORs will match the Mavig Radiation Shield that was furnished for the EP/TAVR room.
5. Added two (2) each red electrical duplex outlets to each Perfusion boom, for a total of eight (8) instead of six (6).
6. iPod and Audio Integration components have been added to the SkyVision Linx300 Integration Systems in both Hybrid rooms.

This completes all of the revisions and these quotes are ready to forward to your contracting staff. Normally our CAD team will begin work on the complete set of Submittal Drawings upon receipt of the PO (or DO), however I will request that they begin work on those as soon as possible. I do know that the jobs with purchase orders in house take precedence over projects that have not been ordered, so I would recommend that you still try to have contracting complete their work as soon as possible.

Please let me know if you have any questions. I appreciate the opportunity to work with all of you and to be of service to our Veterans!

Best Regards,



Pete Jaenchen  
Principal  
Jaenchen Medical Resources



## Summary - presented January 12, 2015

**Quote:**48568 - 3

**Date:**04/25/2014

**Expires:**04/30/2015

**Sales Rep:**Pete Jaenchen

**Email:**[pete@jaenchenmedical.com](mailto:pete@jaenchenmedical.com)

**Phone:**612 802-0447

Jaenchen Medical Resources

2515 Bobolink Rd.

Long Lake MN 55356

**Facility:**VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

**Attn:**Mr. Mike Phelps, Director BIS

**GPO:**VISN 23 - V A Upper Midwest Health Care Network Tier 1  
 FSS - Department of Veterans Affairs Tier 1

We are pleased to quote the following Skytron Products for your review.

Boom I - Equipment Carrier / Anesthesia  
 Boom J - Radiation Shield/Dual LED Light (camera)  
 Boom K - Equipment Carrier / Large Display  
 Boom L - Large Display / Small Display / LED Light  
 Boom M - Perfusion  
 HD In-Light Camera System  
 SkyVision & Displays  
 Equipment Total  
 Installation  
 Handling  
**Total Investment**

Required Deposit

## Terms and Conditions

**Terms** 0.5% 10 days, Net 30 days

Shipping and Taxes are not included in this quote unless itemized above.

**Warranty** 1 year parts and labor on equipment

90 days on replacement parts, supplies, spare bulbs (for surgical lights), pads (for surgical tables) and accessory items  
 15 years on sterilizer pressure vessel (steam chamber and jacket)

**FOB** Destination, prepaid and absorbed to 48 states & Point of Exit to Alaska, Hawaii, and Puerto Rico with overseas freight paid by the government  
 All shipments subject to handling charge

**Delivery** 45 to 120 days after receipt of order

**Deposit** 25% deposit required for non-contracted products upon order acceptance  
 50% deposit required for SkyVision, VACS and Custom products upon order acceptance

**Contract Code** (FSS BPA V797P-4098b)

**Issue PO To** Skytron, LLC | PO Box 888615, Grand Rapids, MI 49588-8615 | 616-656-2900 \* Please include the entire quote number on your P.O.

**Submit PO To** Email to [orders@skytron.us](mailto:orders@skytron.us) or fax to 616-656-2906

**Remit To** Skytron, LLC | 16208 Collections Center Drive, Chicago, IL 60693 | 616-656-2900

**Acknowledgement**

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Title: \_\_\_\_\_

## Boom I - Equipment Carrier / Anesthesia

**Quote:** 48568 - 3

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-G	Pre-Installation Kit for up to 12 gas inlet tubes, includes mounting plate, required for any boom that will accommodate gases
1	1	ETM2F_/2F_	Tandem system with two arm sets on one hub. Fixed height upper arm set (61"/31.5"), fixed height lower arm set (48"/31.5")
1	1	PM48	48" Center-aligned carrier with front shelf supports, 36 outlets, 22" wide, does not include shelves
1	1	H8-200-58	Height Adjustable Flatscreen monitor mount for VST
1	1	H8-010-50-1	Downpost Kit for GCX variable height arm
1	1	H8-300-14	Foot pedal holder 22"W CM, PM, VBM carriers 50 lb weight capacity (Requires PMSH shelf on CM & VBM carriers)
2	2	H8-300-31	Vacuum Slide Premium (PM,KM,XM) carrier bolt on / Not for use on VBM or CM carriers
1	1	H8-300-11	Back cover, 48", hinged
1	1	H8-300-23	CO2 bottle holder, holds 2 E size cylinders
3	3	PMSH	22" Shelf for PM, VBM, CM carriers, includes mounting hardware
1	1	H8-300-17-1	Base utility box, 22", Nitrogen system cutout on right side, required for SkyVac
1	1	H6-305-16_	Nitrogen control system, DISS single outlet, horizontal
2	2	H6-372-01-_	Oxygen outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-03-_	Medical air outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-04-_	Vacuum outlet - OHMEDA (BeaconMedaes standard, others available upon request)
6	6	H7-300-01	Electrical receptacle, duplex, 20A, red, w/ faceplate
2	2	H7-300-03	Electrical receptacle, duplex, 20A, white, w/ faceplate requires H7-300-XX-1 for electrical separation
2	2	H7-300-XX-1	UPGRADE, electrical receptacle mount in base utility box (additional per outlet) +
1	1	H7-310-07	Cable faceplate, stainless, with 2" grommet
1	1	VBM36	36" Vertical Utility Box, 28 outlets, does not include cantilevered shelves, accepts any width shelf
2	2	H8-300-30	Vacuum Slide mounted in carrier rear channel / For use on PM,CM, XM,KM,VBM carriers
2	2	H6-372-01-_	Oxygen outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-02-_	Nitrous oxide outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-03-_	Medical air outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-04-_	Vacuum outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-09-_	WAGD outlet - OHMEDA (BeaconMedaes standard, others available upon request)
6	6	H7-300-01	Electrical receptacle, duplex, 20A, red, w/ faceplate
2	2	H7-300-03	Electrical receptacle, duplex, 20A, white, w/ faceplate requires H7-300-XX-1 for electrical separation
2	2	H7-300-XX-1	UPGRADE, electrical receptacle mount in base utility box (additional per outlet) +

1	1	H2-200-02-C9.5	Extended ceiling cover ring for a total clearance of 12" from top of arm to finished ceiling. Works with two piece rotating cover style only.
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

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**Boom I - Equipment Carrier / Anesthesia Total**

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<http://www.skytron.us/products/pages/booms.html>

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## Boom J - Radiation Shield/Dual LED Light (camera)

**Quote:** 48568 - 3

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-NG	Pre-Installation Kit, includes mounting plate, required for flatscreen or flatscreen with lights only
1	1	LC2ALF_/Lights	Lightweight mount with dual arm system on one hub with surgical lights (59" upper, 35.5" lower) for flatscreen mount, flatscreen mounting bracket required (priced separately). Requires flatscreen power cord(s) (priced separately)
1	1	X-RAY 50010	MAVIG X-Ray Shield 61x76 cm center mounted with cutout and lead panels. AFC arms only
1	1	AUT55TV-1285/1090	Dual fixture with one 24" center focus and 24" camera ready Aurora 3 LED lights on 51"/44" radial arms
1	1	B9-715-03	Triple wall intensity control for Aurora 3 AUT series only
1	1	B9-410-44-1	Wall Control Back Box; Aurora, Stellar & Nautilus Series (triple only).
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

### Boom J - Radiation Shield/Dual LED Light (camera) Total



<http://www.skytron.us/products/pages/booms.html>



<http://www.skytron.us/products/pages/lights.html>

## Boom K - Equipment Carrier / Large Display

**Quote:** 48568 - 3

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-G	Pre-Installation Kit for up to 12 gas inlet tubes, includes mounting plate, required for any boom that will accommodate gases
1	1	ETM2F_/2S_	Tandem system with two arm sets on one hub. Fixed height upper arm set (61"/31.5"), manual height lower arm set (48"/31.5") (UB or VB carriers only)
1	1	PM48	48" Center-aligned carrier with front shelf supports, 36 outlets, 22" wide, does not include shelves
1	1	H8-200-58	Height Adjustable Flatscreen monitor mount for VST
1	1	H8-010-50-1	Downpost Kit for GCX variable height arm
1	1	H8-300-14	Foot pedal holder 22"W CM, PM, VBM carriers 50 lb weight capacity (Requires PMSH shelf on CM & VBM carriers)
2	2	H8-300-31	Vacuum Slide Premium (PM,KM,XM) carrier bolt on / Not for use on VBM or CM carriers
1	1	H8-300-11	Back cover, 48", hinged
1	1	H8-300-23	CO2 bottle holder, holds 2 E size cylinders
3	3	PMSH	22" Shelf for PM, VBM, CM carriers, includes mounting hardware
1	1	H8-300-17-1	Base utility box, 22", Nitrogen system cutout on right side, required for SkyVac
1	1	H6-305-16_	Nitrogen control system, DISS single outlet, horizontal
2	2	H6-372-01_	Oxygen outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-03_	Medical air outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-04_	Vacuum outlet - OHMEDA (BeaconMedaes standard, others available upon request)
6	6	H7-300-01	Electrical receptacle, duplex, 20A, red, w/ faceplate
2	2	H7-300-03	Electrical receptacle, duplex, 20A, white, w/ faceplate requires H7-300-XX-1 for electrical separation
2	2	H7-300-XX-1	UPGRADE, electrical receptacle mount in base utility box (additional per outlet) +
1	1	H7-310-07	Cable faceplate, stainless, with 2" grommet
1	1	CM24	24" Center-aligned carrier without front shelf supports, 16 outlets, accepts any width shelf
1	1	PF60	Display mount with protective frame, will support a 60" or (4) 26" (2 over 2), requires CM24 carrier sold separately
1	1	2SH UPGRADE	Heavy Duty Spring Arm Upgrade
1	1	H2-200-02-C9.5	Extended ceiling cover ring for a total clearance of 12" from top of arm to finished ceiling. Works with two piece rotating cover style only.
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

**Boom K - Equipment Carrier / Large Display Total**



<http://www.skytron.us/products/pages/booms.html>

## Boom L - Large Display / Small Display / LED Light

**Quote:** 48568 - 3

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-NG	Pre-Installation Kit, includes mounting plate, required for flatscreen or flatscreen with lights only
1	1	ECT2S_/2AF_/Lights	Central tandem system with two arm sets on one hub with surgical lights. Manual height upper arm set (61"/31.5") lower arm set for flatscreen mount (51"/35.5") flatscreen mounting bracket required (priced separately). Requires flatscreen power cord(s) (priced separately) (UB, VB or FC3 carriers only)
1	1	CM24	24" Center-aligned carrier without front shelf supports, 16 outlets, accepts any width shelf
1	1	PF60	Display mount with protective frame, will support a 60" or (4) 26" (2 over 2), requires CM24 carrier sold separately
1	1	2SH UPGRADE	Heavy Duty Spring Arm Upgrade
1	1	FC1	Flatscreen Bracket, single monitor mount, 26" max. screen size
1	1	FC1-26	Fc1 Handles Up To 26.5" Wide Requires Fc1
1	1	AUT5-1090	Single fixture with 24" diameter center focus Aurora 3 LED light on 44" radial arm
1	1	H2-200-02-C9.5	Extended ceiling cover ring for a total clearance of 12" from top of arm to finished ceiling. Works with two piece rotating cover style only.
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

### Boom L - Large Display / Small Display / LED Light Total



<http://www.skytron.us/products/pages/booms.html>



<http://www.skytron.us/products/pages/lights.html>

## Boom M - Perfusion

**Quote:** 48568 - 3

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	PRE-INSTALL KIT-G	Pre-Installation Kit for up to 12 gas inlet tubes, includes mounting plate, required for any boom that will accommodate gases
1	1	EC2F_/NL	Central mount with dual arm system, fixed height on one hub without lights (61" upper, 31.5" lower)
1	1	VBM48	48" Vertical Utility Box, 36 outlets, does not include cantilevered shelves, accepts any width shelf
1	1	H8-200-58	Height Adjustable Flatscreen monitor mount for VST
1	1	H8-010-50-1	Downpost Kit for GCX variable height arm
1	1	H8-300-23	CO2 bottle holder, holds 2 E size cylinders
2	2	H8-300-30	Vacuum Slide mounted in carrier rear channel / For use on PM,CM, XM,KM,VBM carriers
2	2	H6-372-01-__	Oxygen outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-03-__	Medical air outlet - OHMEDA (BeaconMedaes standard, others available upon request)
2	2	H6-372-04-__	Vacuum outlet - OHMEDA (BeaconMedaes standard, others available upon request)
1	1	H6-372-09-__	WAGD outlet - OHMEDA (BeaconMedaes standard, others available upon request)
8	8	H7-300-01	Electrical receptacle, duplex, 20A, red, w/ faceplate
2	2	H7-300-03	Electrical receptacle, duplex, 20A, white, w/ faceplate requires H7-300-XX-1 for electrical separation
2	2	H7-300-XX-1	UPGRADE, electrical receptacle mount in base utility box (additional per outlet) +
1	1	H2-200-02-C9.5	Extended ceiling cover ring for a total clearance of 12" from top of arm to finished ceiling. Works with two piece rotating cover style only.
1	1	n/a	Skyboom Mounting Structure and Deflection Testing (furnished and tested by JMR, installed by others)

**Boom M - Perfusion Total**



<http://www.skytron.us/products/pages/booms.html>



## HD In-Light Camera System

**Quote:** 48568 - 3

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
5445 Minnehaha Ave S  
Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	TV-3-AUT	Precision HD camera system for AUT series lights
			<b>HD In-Light Camera System Total</b>

## SkyVision & Displays

**Quote:** 48568 - 3

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
1	1	SVIS-LINX	SkyVision LINX 300 Digital Integration system includes: Medical Grade Touch Panel, Optical Router, IP addressable Control Switch and On-Board Uninterruptable Power Supply.
1	1	SVIS-SECTP	SkyVision LINX 300 Secondary Touch Panel
15	15	SVIS-SOURCE	SkyVision LINX 300 Source Cable Kit includes: 100ft Fiber Optic Cable, DC Power Cable, Faceplate Converter, and 15ft Native Source Cable
12	12	SVIS-DISPLAY	SkyVision LINX 300 Display Cable Kit includes: 100ft Fiber Optic Cable, 100 ft DC Power Cable, DVI Extender Receiver, and Medical Grade Power Supply
1	1	SVIS-12ROUTABLE	SkyVision LINX 300 Extended Routable Displays (up to 4 extra)
1	1	SVIS-AUD	SkyVision LINX 300 Premium Audio Package
1	1	SVIS-POD	SkyVision LINX 300 IPOD Docking Station
4	4	MON-026-LED	FSN HD-Zoom 26" Medical Grade LED Display for surgical and PACS imaging. 1920 X 1080 resolution includes 24VDC power supply, Inputs: DVI, VGA, SDI, Composite, SOG, S-Video, Component, RS-232. Includes Image Zoom compatibility via SkyVision Touch Panel or front panel buttons on the display. Display includes a built-in cable cover.
4	4	MON-CBL-001	Cable Kit - Allows FSN monitor power supply to be up to 75' from the monitor. For FSN 24" and 26" displays only.

**SkyVision & Displays Total**

## Installation

**Quote:** 48568 - 3

**Date:** 04/25/2014

**Expires:** 04/30/2015

**Facility:** VA Midwest Health Care Network VISN 23  
 5445 Minnehaha Ave S  
 Minneapolis MN 55417

Qty	Ext Qty	Item Number	Description
2	2	Installation-D	Central Mount Installation / Lights. Lights priced separately.
2	2	Installation-D	Installation Tandem Mount Systems, includes carrier/carrier and carrier/flatscreen, for models requiring special adapters please include P3-510-06.
1	1	Installation-D	Installation, Single & Dual Arm Systems
2	2	Installation-D	Installation of Aurora, Stellar, Infinity, Millennium and Nautilus
1	1	Installation-D	Addition of TV Function
1	1	Installation-D	Complete Installation, Testing and System Certification for LINX 300 or Hybrid II Digital Series SkyVision; per room.
1	1	Installation-D	Go-Live Support.
			<b>Installation Total</b>

## Supplemental Terms and Conditions

### **Drawing Change Fee.**

\$200.00 drawing change fee will be invoiced after 2nd drawing revision.

### **Change Order Fee.**

Change order fees, equal to five percent (5%) of order total, apply if order changes occur within 60 days prior to shipment.

### **Cancellation Fee.**

Eight percent (8%) cancellation fee will be invoiced or deposit will be forfeited on cancelled items of an equipment order.

### **Minimum Order Fee.**

Orders with a product total less than \$25.00 are subject to a \$20 non-refundable minimum order fee added to the invoice.

### **Re-Stocking Fee.**

- a. Equipment - 20% re-stocking fee will apply to all returns for credit. Refurbishment charges, if any, will be calculated upon inspection of the goods when received. All returns to be authorized by Skytron in advance.
- b. Parts - \$50.00 re-stocking fee for inspection/testing, plus up to five percent (5%) of item cost for repair/refurbishing charge (not to exceed \$2,500 per item). Non-warranty part returns with a List Price less than \$100.00 per item will not be accepted.
- c. Re-Stocking policy does not supersede Skytron's North American Warranty policy, Demo policy, or Table Pad Return policy.

### **Cable Installation.**

Pricing is inclusive of the installation of up to 15 communication cables provided by the minimally invasive surgery equipment supplier at the time of the installation of Skytron product. Additional cables can be installed for a price of \$100.00 each. Please verify number of cables for accurate pricing. Skytron SkyVision systems are exempt.

### **Final Adjustments.**

Final adjustments included in all installation pricing.

### **Miscellaneous.**

- a. Unless otherwise noted, Skytron reserves the right to make product improvements, discontinue products, and change prices without notice.
- b. Orders are subject to credit approval.
- c. Unless otherwise noted or previously negotiated, quoted amounts Do Not Include freight costs and applicable taxes. Freight and tax rates in effect at time of shipment will be applied.
- d. Buyer expressly agrees that no terms and conditions shall supersede those in this quote without express, written consent of Skytron.

## Service Terms and Conditions

### **Working Hours.**

All service and installation pricing is based on normal working hours, 8 AM to 5 PM, Monday thru Friday, excluding holidays.

### **Disconnection and Removal of Existing Equipment.**

If required, for a fee, Skytron can disconnect and remove existing equipment.

### **Union Labor.**

Facilities requiring the use of union labor must be identified as such for quoting purposes.

### **Seismic Requirements.**

Please notify Skytron's Service Manager for installations having specific seismic requirements. Skytron is not responsible for any x-raying of the floor, structural ceiling through bolting, and associated fasteners.

### **Trade-in Equipment.**

Please notify Skytron's Service Manager for installation where trade-in equipment will be present.

### **Combination Products.**

For integrated products combining lighting and equipment pendants, include installation pricing for both individual units.

### **Scheduling.**

Contact Skytron's Service Manager a minimum of 15 working days prior to desired installation date. Large and intensive projects requiring multiple phases require a minimum 60-day notice before installation commences. Please contact Skytron's National Service Manager or Sales Representative.

### **Service Contracts.**

A signed service contract is required. A preliminary evaluation of product may be required for product that has been in use for some time.

### **Electrical Connections, Final Tie-Ins and Finishes.**

All final tie-ins of electrical connections, plumbing and media must be made by a qualified and licensed individual. Skytron does not provide final tie-in services due to local licensing regulations. Finish work (e.g., caulking and trim) is the responsibility of others. Installation of standard product moldings or trim is included in the pricing provided.

PROJECT NO. 618-COI-100  
Renovate to Create Hybrid OR, Phase 2  
100% CD Issue  
03-30-2015

- - - E N D - - -

**SECTION 12 31 00**  
**MANUFACTURED METAL CASEWORK**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies metal casework and related accessories, including base cabinets, wall cabinets, and full height cabinets.
- B. Items specified in this section:
  - 1. Laboratory and Hospital Casework: Prefixed by "VL" AND "M", including metal casework of the following types:
    - a. Wardrobe Cabinet, Metal, 5A (SD123100-02).
    - b. Wall Cabinet, Metal, 5B (SD123100-01).

**1.2 RELATED WORK**

- A. Electrical Components: Division 26, ELECTRICAL.

**1.3 QUALITY ASSURANCE**

- A. Approval by Contracting Officer of proposed manufacturer, or suppliers, will be based upon submission by Contractor certification that, manufacturer regularly and presently manufactures casework specified as one of their principal products.
- B. Installer has technical qualifications, experience, trained personnel, and facilities to install specified items.
- C. Furnish supervision of installation at construction site by a qualified technician regularly employed by casework installer.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
  - 1. Manufacturer's Certificate of qualifications specified and finish on casework.
  - 2. Contractor's Certificate of installer's qualifications specified.
  - 3. Safety glass meets requirements of ANSI Standard Z97.1.
- C. Manufacturer's Literature and Data:
  - 1. Brochures showing name and address of manufacturer, and catalog or model number of each item incorporated into the work.
  - 2. Manufacturer's illustration and detailed description.
  - 3. List of deviations from contract specifications.
  - 4. Locks, each kind
- D. Shop Drawings (1/2 Full Scale):

1. Showing details of casework construction, including kinds of materials and finish, hardware, accessories and relation to finish of adjacent construction, including specially fabricated items or components.
2. Fastenings and method of installation.
3. Location of service connections and access.

E. Samples:

1. Metal plate, 150 mm (six inch) square, showing chemical resistant finish, in each color.
2. One complete casework assembly, including cabinet(s) with drawers and cupboard.
3. One glazed sliding door with track and pertinent hardware. A complete cabinet may be submitted to fulfill this requirement.
4. Cabinets for subsequent installation may be submitted for above requirements.

**1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.

SPEC WRITER NOTE: Update applicable publications to current issue at time of project specification preparation.

B. American Society for Testing and Materials (ASTM):

A36/A36M-08.....Carbon Structural Steel  
A167-99(R 2009).....Stainless and Heat-Resisting Chromium Steel  
Plate Sheet and Strip  
A283/A283M-03(R 2007)...Low and Intermediate Tensile Strength Carbon  
Steel Plates  
A568/A568M-09.....Steel, Sheet, Carbon and High-Strength, Low-  
Alloy Hot-Rolled and Cold-Rolled, General  
Requirements  
A794/A794M-09.....Standard Specification for Commercial Steel  
(CS), Sheet, Carbon (0.16% Maximum to 0.25%  
Maximum) Cold Rolled  
B456-03(R2009).....Electrodeposited Coatings of Copper Plus Nickel  
Plus Chromium and Nickel Plus Chromium  
C1036-06.....Flat Glass

C. American National Standard Institute:

Z97.1-09.....Safety Glazing Material used In Buildings

D. Builders Hardware Manufacturers Association (BHMA):



- A156.1-06.....Butts and Hinges
- A156.9-10.....Cabinet Hardware
- A156.5-10.....Auxiliary Locks and Associated Products
- A156.11-10.....Cabinet Locks
- A156.16-02.....Auxiliary Hardware
- E. American Welding Society (AWS):
  - D1.1-10.....Structural Welding Code Steel
  - D1.3-08.....Structural Welding Code Sheet Steel
- F. National Association of Architectural Metal Manufacturers (NAAMM):
  - AMP 500-505-06 Series...Metal Finishes Manual
- G. U.S. Department of Commerce, Product Standard (PS):
  - PS 1-95.....Construction and Industrial Plywood
- H. Federal Specifications (Fed. Spec.):
  - FF-N-836D.....Nut, Square, Hexagon Cap, Slotted, Castle  
Knurled, Welding and Single Ball Seat
  - A-A-55615.....Shield, Expansion; Nail Expansion (Wood Screw  
and Lag Bolt Self-Threading Anchors)

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Sheet Steel: (Base Bid)
  - 1. ASTM A794, cold rolled, Class 1 finish, stretcher leveled.
  - 2. Other types of cold rolled steel meeting requirements of ASTM A568 may be used for concealed parts.
- B. Structural Steel: ASTM A283 or ASTM A36.
- C. Stainless Steel: ASTM A167, Type 302B. (Bid Option #3)
- D. Glass:
  - 1. ASTM C1036 Type I, Class 1, Quality q3,
  - 2. For Doors: 6 mm (1/4 inch) thick; except where laminated glass is shown.
  - 3. For shelves: Either 6 mm (1/4 inch) or 9 mm (3/8 inch) thick.
- E. Laminated Glass: Fabricate of two sheets of 3 mm (1/8 inch) thick clear glass, laminated together with a 1.5 mm (0.060 inch) thick vinyl interlayer, to a total overall thickness of 8 mm (5/16 inch).
- F. Glazing Cushions:
  - 1. Channel shaped, of rubber, vinyl or polyethylene plastic, with vertical flanges not less than 2 mm (3/32 inch) thick and horizontal web 3 mm (1/8 inch) thick.
  - 2. Flanges may have bulbous terminals above the glazing heads or terminate flush with top of beads.

G. Plywood:

1. Prod. Std. PS 1, seven ply, interior.
2. Where both sides are exposed, use Grade AA.
3. Grade AB for other uses.

H. Fasteners:

1. Exposed to view, chrome plated steel or stainless steel, or finished to match adjacent surface.
2. Use round head or countersunk fasteners where exposed in cabinets.
3. Expansion Bolts: Fed Spec. A-A-55615. Do not use lead or plastic shields.
4. Nuts: Fed Spec FF-N-836. Type III, Style 15 where exposed.
5. Sex Bolts: Capable of supporting twice the load.

**2.2 MANUFACTURED PRODUCTS**

- A. When two or more units are required, use products of one manufacturer.
- B. Manufacturer of equipment assemblies, which include components made by other, shall assume complete responsibility for the final assembled unit.
- C. Constituent parts which are alike, use products of a single manufacturer.

**2.3 CASEWORK FABRICATION**

A. General:

1. Welding: Comply with AWS Standards.
2. Reinforce with angles, channels, and gussets to support intended loads, notch tightly, fit and weld joints.
3. Constructed of sheet steel, except where reinforcing required.

B. Minimum Steel Thickness:

0.89 mm (0.035 inch) (20 gage)	Drawer fronts, backs, bodies, closure plates or scribe and filler strips less than 75 mm (three inches) wide, sloping top, shelf reinforcement channel and shelves. Toe space or casework soffits and ceilings under sloping tops.
1.20 mm (0.047 inch) (18 gage)	Base pedestals, casework top sides, back, and bottom panels, closure scribe and filler strips 75 mm (three inches) or more. Reinforcement for drawers with locks. Tables legs, spreaders and stretchers, when fabricated of cold rolled tubing. Metal for desks; except legs and aprons. Door exterior and interior panels, flush or glazed. Cross rails of base units. Front bottom rails, back bottom rails; rails may be 1.49 mm (0.059 inch) (16 gage) thick. Uprights or posts. Top corner gussets.

1.49 mm (0.059 inch) (16 gage)	Aprons, apron division, reinforcing gussets, table legs, desk legs and aprons, spreaders and stretchers when formed without welding. Toe base gussets, drawer slides, and other metal work. Front top rails and back rails except top back rails may be 1.2 mm (0.047 inch) (18 gage) thick.
1.88 mm (0.074 inch) (14 gage)	Drawer runners door tracks.
2.64 mm (0.104 inch) (12 gage)	Base unit bottom corner gussets and leg sockets.
3 mm (0.12 inch) (11 gage)	Reinforcement for hinge reinforcement inside doors and cabinets.

C. Casework Construction:

1. Welded assembly.
2. Fabricate with enclosed uprights or posts full height or width at front, include sides, backs, bottoms, soffits, ceilings under sloping tops, headers and rail, assembled to form an integral unit.
3. Form sides to make rabbeted stile 19 to 28 mm (3/4 to 1-1/8 inch) wide, closed by channel containing shelf adjustment slots.
4. Make bottom of walls units flush, double panel construction.
5. Make top and cross rails of "U" shaped channel.
6. Provide enclosed backs and bottoms in cabinets, including drawer units.
7. Provide finish panel on exposed cabinet backs.
8. Do not use screws and bolts in construction or assembly of casework, except to secure hardware, applied door stops, accessories, removable panels and where casework is required to fastened end to end or back to back.
9. Fabricate casework, except benches, and desks with finished end panels.
10. Close flush exposed soffits of wall hung shelving, knee spaces in counters, and toe spaces at bases.
11. In base units with sinks provide one piece, lowered backs.
12. In base units with doors provide removable backs.
13. Provide built-in raceways or tubular or channel shaped members of casework for installation of wiring and electric work. Mount junction boxes on rear of cabinets, Electric work is specified in electrical sections of specifications.
14. Provide reinforcing for hardware.

15. Size Dimensions:

a. Used dimensions shown or specified within tolerances specified.

b. Tolerance:

- 1) Depth: 325 mm (13 inches) in lieu of 300 mm (12 inches), 450 mm (18 inches) in lieu of 400 mm (16 inches), except wall hung units above counter. 525 mm (21 inches) to 600 mm (24 inches) in lieu of 550 mm (22 inches).
- 2) Width: Minus 25 mm (one inch).
- 3) Height: 25 mm (one inch) plus or minus for wall hung cabinets and counter mounted cabinets, excluding sloping tops. 25 mm (one inch) plus for floor standing cabinets, excluding base and sloping tops. Full height cabinets shown back to back same height.
- 4) Manufacturer's tolerance for the same length, depth or height: Not to exceed 1.58 mm (0.0625 inches).

D. Base Pedestals:

1. Provide adjustable leveling bolts accessible through stainless steel plugs, or notch in the base concealed when resilient base is applied.
2. Except where flush metal base is shown, provide toe space at front recessed 75 mm (3 inches).

E. Doors:

1. Hollow metal type, flush and glazed doors not less than 16 mm (5/8 inch) thick.
2. Fabricate flush metal doors of two panels formed into pans with corners welded and ground smooth. Provide flush doors with a sound deadening core.
3. Fabricate glazed metal doors with reinforced frame and construct either from one piece of steel, or have separate stiles and rails mitered and welded at corners, and welds ground smooth.
  - a. Secure removable glazing members with screws to back of doors.
  - b. Install glass in rubber or plastic glazing channels.
4. Provide sheet steel hinge reinforcement inside doors.
5. Sliding doors: Provide stops to prevent bypass.
6. Doors removable without use of tools except where equipped with locks.

F. Drawers:

1. Drawer fronts flush hollow metal type not less than 16 mm (5/8 inch) thick with sound deadening core. Fabricate of two panels formed into pans. Weld and grind smooth corners of drawer fronts.
2. Form bodies from one piece of steel, weld to drawer front.

3. Provide reinforcement for locks and provide rubber bumpers at both sides of drawer head to cushion closing.
4. Equip with roller suspension guides.

G. Sloping Tops:

1. Provide sloping tops for casework where shown.
2. Where ceilings interfere with installation of sloping tops. Provide filler plates as specified.
3. Omit sloping tops or filler plates whenever ceiling material is turned down and furred-in at face of casework.
4. Provide exposed ends of sloping tops with flush closures.
5. Fasten sloping tops with sheet metal screws inserted from cabinet interior; space fastener as recommended by manufacturer.

H. Shelves:

1. Capable of supporting an evenly distributed minimum load of 122 kg/m<sup>2</sup> (twenty-five pounds per square foot) without visible distortion.
2. Flange shelves down 19 mm (3/4 inch) on edges, with front and bearing edges flanged back 13 mm (1/2 inch).
3. For shelves over 1050 mm (42 inches) in length and over 300 mm (12 inches) in depth install 38 mm by 13 mm by 0.9 mm (1-1/2 x 1/2 x 0.0359 inch) thick sheet steel hat channel reinforcement welded to underside midway between front and back and extending full length of shelf.
4. Weld shelves to metal back and ends unless shown adjustable.
5. Provide means of positive locking shelf in position, and to permit adjustment without use of tools.
6. On pharmacy on sloping shelf provide 13 mm (1/2 inch) wide clear acrylic plastic raised edge, 3 mm (1/8 inch) thick, secured to front edge of shelf.

I. Undercounter Table and Bench Frames:

1. Using welded construction.
2. Open frame type with aprons and legs when required.
3. Aprons:
  - a. Channels shaped welded at corners, with leg sockets and reinforcing triangular corner gussets welded in corners.
  - b. Pierce sockets to receive leg bolts and notch gussets to receive legs.
  - c. Upper flange perforated or slotted to receive screws at 200 mm (8 inch) centers, and back channels when installed against wall. Size slots for 6 mm (1/4 inch) anchor bolts.

- d. Pierce aprons to receive drawer formation, rail at top of drawer opening. Install channel shaped apron division welded at ends, 762 mm 30 inches apart to front and back aprons, or at each side of drawer.
  - e. Fabricate metal components from sheet steel.
    - 1) Use 1.5 mm (0.0598 inch) thick sheet for gussets and channel aprons.
    - 2) Use 1.2 mm (0.0478 inch) thick sheet for other items.
  - f. At knee space, provide exposed metal sides and metal closure plate for soffit. Where shown at knee space, provide exposed metal back secured with continuous angle closures at both side.
4. Legs:
- a. Cold rolled tubing or 1.5 mm (0.0598 inch) formed steel.
  - b. Leveling-anchoring device at floor.
  - c. Stud bolt at top for attachment to leg socket.
5. Leg Braces:
- a. Tables and benches not anchored to walls.
  - b. Brace back against front legs near bottom with steel angle, channel or tubular braces.
  - c. Fasten braces together with steel straps.
6. Leg Shoes:
- a. Fit laboratory casework legs at bottom with either stainless steel, aluminum, or chromium plated brass shoes, not less than 25 mm (one inch) in height.
  - b. Fit other legs with a movable molded vinyl shoe 100 mm (four inches) high and coved at bottom.
- J. Closures and Filler Strips at Pipe Spaces:
- 1. Flat steel strips or plates.
  - 2. Openings less than 200 mm (8 inches) wide: 1.2 mm (0.047 inch) thick.
  - 3. Openings more than 200 mm (8 inches) wide 0.9 mm (0.359 inches) wide.

## **2.4 ACCESSORIES**

- A. Card or Label Holders for Shelves:
- 1. Fabricate of 0.6 mm (0.0239 inch) thick steel approximately 125 mm (five inches) long, or continuous where shown, having top and bottom edges bent over on face and welded to shelf.
  - 2. Finish exposed surfaces in same color as shelf.
- B. Labels Holders for Doors and Drawers:
- 1. Cast or wrought brass or aluminum, 50 mm (2 inch) by 88 mm (3-1/2 inch).
  - 2. Fasten to casework as recommended by manufacturer.

C. Shadow Boards in Cabinet VL 33:

1. Plywood of size and thickness shown with exposed edges chamfered.
2. Secure boards to back of exterior metal doors and cabinet back with screws.
3. Use pivot top and bottom hinges on intermediate boards with pulls on each leaf.
4. Paint exposed surfaces of shadow boards two shop coats of shellac.

**2.5 HARDWARE**

A. Factory installed.

B. Exposed hardware, except as specified otherwise, satin finished chromium plated brass or nickel plated brass or anodized aluminum.

SPEC WRITER NOTE: Verify locks are shown on details for cabinets.

C. Cabinet Locks:

1. Where locks are shown.
2. Locked pair of hinged door over 900 mm (36 inches) high:
  - a. ANSI/BHMA A156.5, similar to E0261, Key one side.
  - b. On active leaf use three-point locking device, consisting of two steel rods and lever controlled cam at lock, to operate by lever having lock cylinder housed therein.
  - c. On inactive leaf use dummy lever of same design.
  - d. Provide keeper holes for locking device rods and cam.
  - //e. Use two point locking device both doors of cabinet 6D similar to ANSI/BHAMA A156.5, E0251, Key one side. //
3. Door and Drawer: ANSI/BHMA A156.11 cam locks.
  - a. Drawer and Hinged Door up to 900 mm (36 inches) high: E07261.
  - b. Pin-tumbler, cylinder type lock with not less than four pins. Disc tumbler lock "duo A" with brass working parts and case, as manufactured by Illinois Lock Company are acceptable.
  - c. Sliding Door: E07161.
4. Key locks differently for each type casework and master key for each service, such as Nursing Units, // Psychiatric, // Administrative, // Pharmacy //.
  - a. Key drug locker inner door different from outer door.
  - b. Provide two keys per lock.
  - c. Provide six master keys per service or Nursing Unit.
5. Marking of Locks and Keys:
  - a. Name of manufacturer, or trademark which can readily be identified legibly marked on each lock and key change number marked on exposed face of lock.

- b. Key change numbers stamped on keys.
  - c. Key change numbers to provide sufficient information for manufacturer to replace key.
- D. Cabinet Hardware: ANSI BHMA A156.9.
- 1. Door/Drawer Pulls: B02011.
    - a. One for drawers up to 575 mm (23 inches) wide.
    - b. Two for drawers over 575 mm (23 inches) wide.
    - c. Sliding door flush pull, each door: B02201.
  - 2. Door in seismic zones: B03352.
    - a. Do not provide thumb latch on doors equipped with three point locking device.
    - b. Use lever operated two point latching device on paired doors over 900 mm (36 inches) high if three point locking or latching device is not used.
  - 3. Cabinet Door Catch:
    - a. Install at bottom of wall cabinets, top of base cabinets and top and bottom of full height cabinet doors over 1200 mm (48 inches).
    - b. Omit on doors with locks.
  - 4. Drawer Slides:
    - a. Use B05051 for drawers over 150 mm (6 inches) deep.
    - b. Use B05052 for drawers 75 to 150 mm (3 to 6 inches) deep.
    - c. Use B05053 for drawers less than 75 mm (3 inches) deep.
  - 5. Butt Hinges:
    - a. B01351, minimum 1.8 mm (0.072 inch) thick chrome plated steel leaves.
    - b. Minimum 3.5 mm (0.139 inch) diameter stainless steel pins.
    - c. Full mortise type, five knuckle design with 63 mm (2-1/2 inch) high leaves and hospital type tips.
    - d. Two hinges per door except use three hinges on doors 1200 mm (48 inches) and more in height. Use stainless steel leaves for tilting bin doors.
    - f. Do not weld hinges to doors or cabinets.
  - 6. Pivot hinges: ANSI/BHMA A156.1 A875B.
  - 7. Shelf Supports:
    - a. install in casework where adjustable shelves are noted.
    - b. Adjustable Shelf Standards: B04061 with shelf rest B04081.
    - c. Vertical Slotted Shelf Standard: B04102 with shelf brackets B04112 sized for shelf depth.
  - 8. Sliding Doors:



- a. Doors supported by two ball bearing bronze or nylon rollers or sheaves riding on a stainless steel track.
- b. Sliding Door Tracks: B07093. Plastic tracks not acceptable.
- c. Doors restrained by a nylon, polyvinylchloride, or stainless steel guide at opposite end.
- 9. Auxiliary Hardware: ANSI A156.16.
- 10. Door silencers: L03011 or L03031.
  - a. Install two rubber bumpers each door.
  - b. Silencers set near top and bottom of jamb.
- 11. Closet Bar: L03131 chrome finish of required length.

## 2.6 METAL FINISHES

- A. Comply with NAAMM 500 series and as specified.
- B. Steel Cabinets including Closures and Filler Strips:
  - 1. Acid resisting finish except hardware and stainless steel.
  - 2. After fabrication of cabinet submerge in a degreasing bath, and thoroughly rinse to remove dirt and grease, and other foreign matter.
  - 3. Apply non-metallic phosphate coating, then finish with baked-on acid resisting enamel not less than one mil thick.
  - 4. Finish resistant to action of the following reagents when 10 drops (0.5 cm<sup>3</sup>) are applied to the surface and left open to the atmosphere for period of one hour.

Hydrochloric Acid 37 percent	Ethyl Alcohol
Phosphoric Acid 75 percent	Methylethyl Keytone
Sulfuric Acid 25 percent	Acetone
Glacial Acetic Acid	Ethyl Acetate
Sodium Hydroxide 10 percent	Ethyl Ether
Sodium Hydroxide (concentrated)	Carbon Tetrachloride
Ammonia Hydroxide (concentrated)	Xylene
Hydrogen Peroxide 5 percent	Phenol 85 Percent
Formaldehyde 37 percent	

- 5. Color of finish is specified in Section, INTERIOR/EXTERIOR FINISHES, MATERIALS, AND FINISH SCHEDULES.

- C. Brass:
  - 1. U.S. Standard Finish No. 26 for hardware items.
  - 2. Other brass items: ASTM B456, chromium plated finish meeting requirements for Service Condition SCI.
- D. Aluminum: Chemically etched medium matte, clear anodic coating, Class II, Architectural, 0.4 mils thick.

- E. Stainless Steel: Mechanical finish No. 4 on sheet except No. 7 on tubing.

## **2.7 DISPENSING TRAYS AND BINS**

- A. Design trays and bins to fit cabinets where shown.
- B. Fabricate of steel, polypropylene, fiberglass reinforced polyester resin, or other suitable material.
- C. Lock securely in place without the use of tools.
- D. Fit at angle to provide gravity feed where shown.
- E. Dispensing Trays:
  - 1. Equip trays with two longitudinal dividers adjustable to three position.
  - 2. Approximate dimensions: 150 mm (6 inches) in width 75 mm (3 inches) in depth, and length to suit cabinets depth furnished.
- F. Dispensing Bins:
  - 1. Open front, except for retaining rim.
  - 2. Approximate dimensions: 150 mm (6 inches) in width, 125 mm (5 inches) in depth, and length to suit cabinets furnished.

## **2.8 ELECTRICAL FIXTURES**

- A. Comply with requirements of Division 26 - ELECTRICAL specifications for fixtures, receptacles, wiring and junction boxes required for fixtures and receptacles, included with casework.
- B. Suitable for use with electrical system specified and shown.
- C. Factory install in casework.

## **2.9 VL 33**

- A. Construct as shown.
- B. Use pivot hinges on center shadow boards, secured to bottom and top of cabinet with bolts or screws.

## **2.10 SUSPENSION SYSTEM FOR INTERCHANGEABLE CASEWORK:**

- A. Suspension system shall provide for independent suspension of interchangeable under-counter cabinets and of countertops. Provide for removal or exchange of under counter cabinets of various heights, widths and types, and for vertical adjustment of counter tops to heights indicated on drawings.
- B. Suspension Frames: Fabricate of 32 mm (1-1/4 inch square) or 25 mm (1 inch) x 38 mm (1-1/2 inch) rectangular, 2.6 mm (0.104 inch) (12 gauge) steel tubing welded to form full rectangle. Provide integral, adjustable leveling device in steel leg with non marring foot cap.
- C. Mounting channels and support frames shall allow for pipe chases and service channels when required.

- D. Cabinets to have an 1.49 mm (0.059 inch) steel shaped form welded across entire width of back to engage continuous slot in wall mounting channel. Two fastening devices through case stile at front shall provide final positive location and locking of case in position.
- E. All construction materials that are exposed shall be painted.

#### **2.11 WHEELED CARRIER**

Provide a wheeled carrier to facilitate installation, removal, and transport of interchangeable cases as part of the interchangeable laboratory furniture system.

### **PART 3 - EXECUTION**

#### **3.1 COORDINATION**

- A. Before installing casework, verify wall and floor surfaces covered by casework have been finished.
- B. Verify location and size of mechanical and electrical services as required.
- C. Verify reinforcement of walls and partitions for support and anchorage of casework.

#### **3.2 FASTENINGS AND ANCHORAGE**

- A. Do not anchor to wood ground strips.
- B. Provide hat shape metal spacers where fasteners span gaps or spaces.
- C. Use 6 mm (1/4 inch) diameter toggle or expansion bolts, or other appropriate size and type fastening device for securing casework to walls or floor. Use expansion bolts shields having holding power beyond tensile and shear strength of bolt and breaking strength of bolt head.
- D. Use 6 mm (1/4 inch) diameter hex bolts for securing cabinets together.
- E. Use 6 mm (1/4 inch) by minimum 38 mm (1-1/2 inch) length lag bolt anchorage to wood blocking for concealed fasteners.
- F. Use not less than No. 12 or 14 wood screws with not less than 38 mm (1-1/2 inch) penetration into wood blocking.
- G. Space fastening devices 300 mm (12 inches) on center with minimum of three fasteners in 900 or 1200 mm (three or four foot) unit width.
- H. Anchor floor mounted cabinets with a minimum of four bolts through corner gussets. Anchor bolts may be combined with or separate from leveling device.
- I. Secure cabinets in alignment with hex bolts or other internal fastener devices removable from interior of cabinets without special tools. Do not use fastener devices which require removal of tops for access.

- J. Where units abut end to end anchor together at top and bottom of sides at front and back. Where units are back to back anchor backs together at corners with hex bolts placed inconspicuously inside casework.
- K. Where type, size, or spacing of fastenings is not shown or specified, show on shop drawings proposed fastenings and method of installation.

### **3.3 CLOSURES AND FILLER PLATES**

- A. Close openings larger than 6 mm (1/4 inch) wide between cabinets and adjacent walls with flat, steel closure strips, scribed to required contours, or machined formed steel fillers with returns, and secured with sheet metal screws to tubular or channel members of units, or bolts where exposed on inside.
- B. Where ceilings interfere with installation of sloping tops, omit sloping tops and provide flat steel filler plates.
  - 1. Secure filler plates to casework top members, unless shown otherwise.
  - 2. Secure filler plates more than 150 mm (six inches) in width top edge to a continuous 25 by 25 mm (one by one inch) 0.889 mm thick steel formed steel angle with screws.
  - 3. Anchor angle to ceiling with toggle bolts.
- C. Install closure strips at exposed ends of pipe space and offset opening into concealed space.
- D. Paint closure strips and fillers with same finishes as cabinets.
- E. Caulk and seal laboratory furniture as specified in Section 07 92 00, JOINT SEALANTS.

### **3.4 CABINETS**

- A. Install in available space; arranged for safe and convenient operation and maintenance.
- B. Align cabinets for flush joints except where shown otherwise.
- C. Install cabinets level with bottom of wall cabinets in alignment and tops of base cabinets aligned.
- D. Install corner cabinets with hinges on corner side with filler or spacers sufficient to allow opening of drawers.
- E. Plug Buttons:
  - 1. Install plug buttons in predrilled or prepunched perforations not used.
  - 2. Use chromium plate plug buttons or buttons finish to match adjacent surfaces.
- F. Cabinets 6D: Ground to nearest cold water pipe in accordance with NFPA, Underwriters Laboratories, Inc., or other nationally recognized laboratory approved ground specified system.

**3.5 PROTECTION TO FIXTURES, MATERIALS, AND EQUIPMENT**

- A. Tightly cover and protect cabinets against dirt, water chemical or mechanical injury.
- B. Thoroughly clean interior and exterior of cabinets, at completion of all work.

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**SECTION 13 49 00  
RADIATION PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies lead radiation shielding.
- B. Construction of products and assemblies used for radiation shielding complying with applicable requirements of NCRP Reports 147 and 102.
- C. This section includes the following items:
  - 1. Lead Lined Gypsum Wallboard

**1.2 RELATED WORK**

- A. Structural steel: Section 05 50 00, METAL FABRICATIONS.

**1.3 MANUFACTURERS QUALIFICATIONS**

- A. Approval by Contracting Officer is required of product or service of proposed manufacturer and suppliers, and will be based upon submission by Contractor of certification that:
  - 1. Manufacturer regularly and presently manufactures lead radiation shielding as specified as one of its principal products.
  - 2. Manufacturer's product submitted has been in satisfactory and efficient operation or three installations similar and equivalent to this project for three years.
  - 3. Manufacturer submits list of installations.

**1.4 TESTS**

- A. Lead radiation shielding will be tested at the expense of the Government after X-ray equipment is installed.
- B. Any additional testing required due to correction and replacement of defective work will be done by the Government at Contractor's expense.  
**NOTE:** Lead glass, lead lined concrete masonry units, lead lined gypsum lath, lead lined gypsum wallboard and lead lined plywood will not be tested prior to installation.

**1.5 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Each lead radiation shielding item specified showing thickness of lead, details of construction and installation.
- C. Samples:
  - 1. Lead lined concrete masonry units, gypsum lath and gypsum wallboard.

2. Bottom corner section of lead lined door, 300 mm (12 inches) square showing bottom and side edge strips.

D. Manufacturers' Literature and Data: Each lead radiation shielding item specified.

#### **1.6 WARRANTY**

- A. Warranty lead lined doors against defects in workmanship and materials subject to terms of "Warranty of Construction" Article in GENERAL CONDITIONS, except that warranty period shall be two years.
- B. Warp or twist of lead lined flush veneered doors may not exceed 6 mm (1/4 inch) in any face dimension of door (including full diagonal), measured not less than six months after doors have been hung and finished.

#### **1.7 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):  
QQ-L-201F(2).....Lead Sheet
- C. American Society for Testing and Materials (ASTM):  
A167-99(2009).....Stainless and Heat Resisting Chromium-Nickel  
Steel Plate, Sheet and Strip  
C1396/C1396M-04.....Gypsum Wallboard/Gypsum Lath  
C90-11.....Load-Bearing Concrete Masonry Units  
C1002-07.....Steel Drill Screws for the Application of Gypsum  
Board or Metal Plaster Bases  
D1187-97(R2002).....Asphalt-Base Emulsions for Use as Protective  
Coatings for Metal
- D. United States Department of Commerce Product Standard (PS):  
FED PSI 83-84.....Construction and Industrial Plywood
- E. Military Specifications (Mil. Spec.):  
MIL-C-36373.....Cabinet, Cassette Transfer, Wall Mounted
- F. National Council on Radiation Protection and Measurements (NCRP):  
Report 147.....Structural Shielding Design for Medical X-Ray  
Imaging Facilities (2004)  
Report 102.....Medical X-Ray, Electron Beam and Gamma-Ray  
Protection for Energies up to 50 MeV (Equipment  
Design, Performance and Use), (1989)

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Lead Lined Gypsum Wallboard:
  - 1. ASTM C1396, Type X, 16 mm (5/8 inch) thick.
  - 2. Factory bond sheet lead to one side of wallboard.
  - 3. Apply sheet lead in thicknesses shown, unpierced and in one piece.
- B. Fasteners:
  - 1. Cadmium or chromium plated steel screws for securing lead louvers.
  - 2. Standard steel drill screws, ASTM C1002, with lead washers for application of lead lined sheet materials to metal studs and attach washers in accordance with shielding manufacturer's instructions.
  - 3. Nails:
    - a. Use barbed lead head nails for application of lead lined materials to wood furring strips.
    - b. Long enough to penetrate furring strips not less than 25 mm (one inch).
    - c. Cast-lead head sufficiently thick to equal lead shielding of room provided.
- C. Lead Discs: Same thickness as lead lining, diameter 25 mm (1 inch) larger than fastener.

## **PART 3 - EXECUTION**

### **3.5 LEAD LINED GYPSUM WALLBOARD PANELS**

- A. Apply lead lined gypsum wallboard to metal studs as shown.
- B. Predrill or drill pilot holes for nails or screws as necessary to prevent deformation of the fastener and lead shielding and to prevent distortion of the wallboard.
- C. Apply wallboard vertically with lead linings placed next to supports.
- D. Install sheet lead strips behind joints not less than the thickness used for the wallboard.
  - 1. The lead strips: 45 mm (1-3/4 inches) wide, except at corner joints, 45 mm by 45 mm (1-3/4 by 1-3/4 inch) lead angles shall be used.
  - 2. Secure the lead strips to supports at outer edges of strips.
- E. Wallboard:
  - 1. fastened to supports with screws and lead washers or discs at approximately 250 mm (ten inches) on centers.



2. Make provisions for connection with lead lined door frames and for cutouts for vision panels.
3. Joint treatment of lead lined gypsum board panels and fastening depressions shall be as specified for wallboard in Section 09 29 00, GYPSUM BOARD.

### **3.6 SUPPLEMENTAL LEAD SHIELDING**

- A. Line or cover penetrations of wall lead, pipe chases, columns fasteners and elsewhere where shown with sheet lead. Install sheet lead free of waves, lumps and wrinkles and with as few joints as possible. Joints in sheet lead shall provide X-ray absorption equivalent to adjacent sheet lead finished smooth and neat.
- B. Provide sufficient lead shielding for spaces around outlet boxes, junction boxes, film illuminators, and pipes, to obtain a net radiation protection at these spaces equaling net radiation protection specified for wall or partition in which they occur.

### **3.7 SIGNS: FURNISH SIGNS AS FOLLOWS:**

- A. One for each X-Ray Room, lettered as follows:  
THE PARTITIONS, THE DOORS OF THIS ROOM HAVE BEEN INSULATED WITH SHEET LEAD OF \_\_\_\_\_ mm THICKNESS PROVIDING A TOTAL LEAD EQUIVALENT PROTECTION OF \_\_\_\_ mm.
- B. Signs:
  1. Heavy white paper or cardboard.
  2. Height of lettering and number not less than 3 mm (1/8 inch).
  3. Fill in blank spaces on signs with mm thickness of lead as installed and total mm thickness of lead equivalent (determined by VA Physicist) and height of such insulation where required.
  4. Mount in stainless steel or extruded aluminum frames (with acrylic plastic, 3 mm (1/8 inch) thick over sign) and fasten with suitable screws, one to each corner of each frame.
  5. Provide manufacturer's standard stainless steel frame, to hold card size 100 mm by 150 mm (four by six inches).

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## **RADIATION PROTECTION RECOMMENDATIONS**

Department of Veteran Affairs  
V.A. Medical Center  
One Veterans Drive  
Minneapolis, MN 55417

Hybrid OR Room 20

Hybrid OR Room 21

March 29, 2015

Submitted by:



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Mark Towsley, M.S., DABR  
Certified Diagnostic Medical Physicist

## NOTICE

Pursuant to the MDH rule 4732 all shielded walls must be placard identifying the thickness and material used to shield the wall. 4732.0360 Subp. 7. Permanent placard. A permanent placard must be mounted in the room specifying the amount and type of shielding in each of the all walls, doors, partitions, and, if occupied, spaces above or below, the floor and ceiling. If mounting the information is not practical, a registrant may post a notice in the room that describes the document and states where it may be examined.

## General

Radiation protection recommendations for V.A. Medical Center Hybrid OR Room 20 and Room 21 installation appear in various sections of this report. The radiation protection criteria, sources of applicable data and methods of calculation used to derive the recommendations are discussed. General instructions for the construction of the shielded areas are also included.

The recommended shielding thickness' are for the V.A. Medical Center Hybrid OR Room 20 and Room 21 installation as described on the drawings supplied me and dated 3/16/15 by Nathan Roisen and Victor W. Walker, B W B R 380 St. Peter Street, Suite 600 Saint Paul, MN 55102 . Any changes in machine position or room configuration shall be reviewed by Mark Towsley, M.S., DABR, Certified Medical Physicist.

## Additional Radiation Shielding Required

### Hybrid OR Room 20

#### Walls

Wall A-B must contain at least 1/32 inch of lead. The window will require a minimum of 1/32 inch lead equivalent glass at 120 kVp installed. The height of the lead must, at a minimum, extend to 7 feet above the floor. The window must start no less than 18 inches from the side closed to the door. The door must contain the same equivalent lead thickness of 1/32 inch of lead. 16 gauge steel frame for the door is adequate shielding.

Wall B-C must contain at least 1/32 inch of lead. The height of the lead must, at a minimum, extend to 7 feet above the floor. The door must contain the same equivalent lead thickness of 1/32 inch of lead. 16 gauge steel frame for the door is adequate shielding.

Wall C-D'-D must contain at least 1/32 inch of lead. The height of the lead must, at a minimum, extend to 7 feet above the floor. The door must contain the same equivalent lead thickness of 1/32 inch of lead. 16 gauge steel frame for the door is adequate shielding.

Wall D-E must contain at least 1/32 inch of lead. The height of the lead must, at a minimum, extend to 7 feet above the floor.

Wall A-E must contain at least 1/32 inch of lead. The height of the lead must, at a minimum, extend to 7 feet above the floor.

#### Ceiling

The ceiling does not require any additional shielding if it contains at least 3 inches of concrete.

#### Floor

The floor does not require any additional shielding if it contains at least 3 inches of concrete.

#### Door

As noted in the above paragraphs.

### Calculation Data

Location	Area	Distance		Primary/ Secondary	Occupancy Factor	MPD (mSv/week)
		(ft)	(m)			
A - B	X-Ray Control Booth	17.50	5.3	Secondary	1	0.02
B - C	Corridor	11.00	3.4	Secondary	1/5	0.02
C - D	Corridor	9.00	2.7	Secondary	1/5	0.02
D - E	Office	15.00	4.6	Secondary	1	0.02
A - E	Corridor	15.00	4.6	Secondary	1/5	0.02
Ceiling	3rd Floor Offices	14.5	4.4	Secondary	1	0.02
Floor	1st Floor Offices	14.5	4.4	Secondary	1	0.02

Location	Area	Patient's per week	mA- Minutes	Calculated Lead	Calculated Concrete	Lead	Concrete	Lead	Concrete
				Thickness (inch)	Thickness (inch)	Thickness Present (inch)	Thickness Present (inch)	Thickness Used (inch)	Thickness Used (inch)
A - B	X-Ray Control Booth	21	1350.0	1/87		0.00		1/32	
B - C	Corridor			1/100		0.00		1/32	
C - D	Corridor			1/100		0.00		1/32	
D - E	Office			1/74		0.00		1/32	
A - E	Corridor			1/100		0.00		1/32	
Ceiling	3rd Floor Offices				3.00		4.50		0.00
Floor	1st Floor Offices				3.00		4.50		

### Hybrid OR Room 21

#### Walls

Wall F-G must contain at least 1/16 inch of lead. The window will require a minimum of 1/16 inch lead equivalent glass at 120 kVp installed. The height of the lead must, at a minimum, extend to 7 feet above the floor. The window must start no less than 18 inches from the side closed to the door. The door must contain the same equivalent lead thickness of 1/16 inch of lead. 16 gauge steel frame for the door is adequate shielding.

Wall G-H must contain at least 1/32 inch of lead. The height of the lead must, at a minimum, extend to 7 feet above the floor. The door must contain the same equivalent lead thickness of 1/16 inch of lead. 16 gauge steel frame for the door is adequate shielding.

Wall H-I must contain at least 1/32 inch of lead. The height of the lead must, at a minimum, extend to 7 feet above the floor. The door must contain the same equivalent lead thickness of 1/16 inch of lead. 16 gauge steel frame for the door is adequate shielding.

Wall I-J must contain at least 1/32 inch of lead. The height of the lead must, at a minimum, extend to 7 feet above the floor.

Wall J-K must contain at least 1/32 inch of lead. The height of the lead must, at a minimum, extend to 7 feet above the floor.

Wall F-K must contain at least 1/16 inch of lead. The height of the lead must, at a minimum, extend to 7 feet above the floor.

#### Ceiling

The ceiling does not require any additional shielding if it contains at least 3 inches of concrete.

#### Floor

The floor does not require any additional shielding if it contains at least 3 inches of concrete.

Door

As noted in the above paragraphs.

#### Calculation Data

Location	Area	Distance		Primary/ Secondary	Occupancy Factor	MPD (mSv/week)
		(ft)	(m)			
F - G	X-Ray Control Booth	9.50	2.9	Secondary	1	0.02
G - H	Corridor	12.50	3.8	Secondary	1/5	0.02
H - I	Corridor	11.50	3.5	Secondary	1/5	0.02
I - J	Elivator/Lobby	13.00	4.0	Secondary	1/20	0.02
J - K	Corridor	16.00	4.9	Secondary	1/5	0.02
F - K	Office/Toliet	11.50	3.5	Secondary	1	0.02
Ceiling	3rd Floor Offices	14.5	4.4	Secondary	1	0.02
Floor	1st Floor Offices	14.5	4.4	Secondary	1	0.02

				Calculated Lead Thickness	Calculated Concrete Thickness	Lead Thickness	Concrete Thickness	Lead Thickness	Concrete Thickness
Location	Area	Patient's per week	mA- Minutes	(inch)	(inch)	Present (inch)	Present (inch)	Used (inch)	Used (inch)
F - G	X-Ray Control Booth	20	3190.0	1/18		0.00		1/16	
G - H	Corridor			1/42		0.00		1/32	
H - I	Corridor			1/38		0.00		1/32	
I - J	Elivator/Lobby			1/100		0.00		1/32	
J - K	Corridor			1//54		0.00		1/32	
F - K	Office/Toliet			1//20		0.00		1/16	
Ceiling	3rd Floor Offices				3.00		4.50		0.00
Floor	1st Floor Offices				3.00		4.50		0.00

### Shielding Materials

The shielding material shall be normal construction Gypsum wallboard with lead. The door should be a solid door with lead sandwiched in the middle.

### Penetration of Shielding Materials

Nails and screws are allowed to penetrate through the wall without additional shielding material. Electrical boxes will be backed with at least a minimum of lead for that wall and overlapping the lead in the wall. Conduit, pipes, plumbing, and HVAC shall enter at a height greater than 7 feet, so as not to penetrate the lead shielding.

### Radiation Protection Criteria

The National Council on Radiation Protection and Measurements (NCRP) has recommended Maximum Permissible Dose (MPD) values for the exposure of radiation workers and the general population to ionizing radiation . The NCRP recommendations form the basis of the radiation control regulations adopted by most states, including Minnesota Department of Health (MDH) Ionizing Radiation Rules, Chapter 4730 and are in accordance with the NCRP standards for protection against ionizing radiation.

The following criteria, which were used to determine all radiation protection requirements presented in this report, are based on recommendations of the NCRP and in accordance to Minnesota Department of Health (MDH) Ionizing Radiation Rules chapter 4730.0340.

#### Radiation Workers:

The maximum permissible dose equivalent for radiation workers is 50 millisevert (mSv) per year. Based on the philosophy of ALARA, a shielding design level of the radiation protection provided for all radiation worker occupied areas which, for the purposes of radiation protection can be classified as "Controlled Areas," and shall be such that it will be improbable that the dose received by any individual remaining in that area 1 mSv in one 40 hour work week.

#### General Public:

The maximum permissible dose equivalent for radiation General Public is 1 mSv per year. Based on the philosophy of ALARA, a shielding design level of the radiation protection provided for all members of the general public that occupied areas which, for the purposes of radiation protection can be classified as "Uncontrolled Areas," and shall be such that it will be improbable that the dose received by any individual remaining in that area 0.02 mSv in one 40 hour work week. In addition the maximum dose equivalent in any one hour of operation must be less than 0.02 mSv/hr with an occupancy factor equal to one.

## **Radiation Source Parameters**

#### Workload:

The radiation source parameters and estimated workloads for a typical installation are based on NCRP Report #49 and reference 3. For the purpose of this shielding report a workload of 75 xrays/wk was used. Sufficient safety factors are incorporated into the recommendations to permit the typical workloads to be moderately exceeded without exceeding the exposure limits.

#### Use Factor:

Accelerator use factors used for calculations are from NCRP Report 147 "Structural Shielding Design for Medical X-ray Imaging Facilities.", and are: 1 for floor, 1/4 for walls, and 1/4 ceiling.

#### Occupancy Factor:

Occupancy factors used for calculations are from NCRP Report 147 "Structural Shielding Design for Medical X-ray Imaging Facilities." and are: 1 for full occupancy, 1/4 for partial occupancy, and 1/16 for occasional occupancy.

#### Tube Head Leakage:

Diagnostic-type protective tube housing: An x-ray tube housing so constructed that the leakage measured at a distance of one meter from the source cannot exceed 100 mR in one hour when the tube is operated at its maximum continuous rated current for the maximum rated tube potential.

## Shielding Calculations

The methods of shielding calculation that were used are described in the NCRP Handbook Report #147, NCRP #51, and Shielding Techniques for Radiation oncology Facilities as cited in the references of this report. These techniques were used in all determinations of shielding thickness' for the primary beam, scatter, and leakage. For the specifics of the formalism and data the reader is referred to reference 3 and addendum 1 to this report.

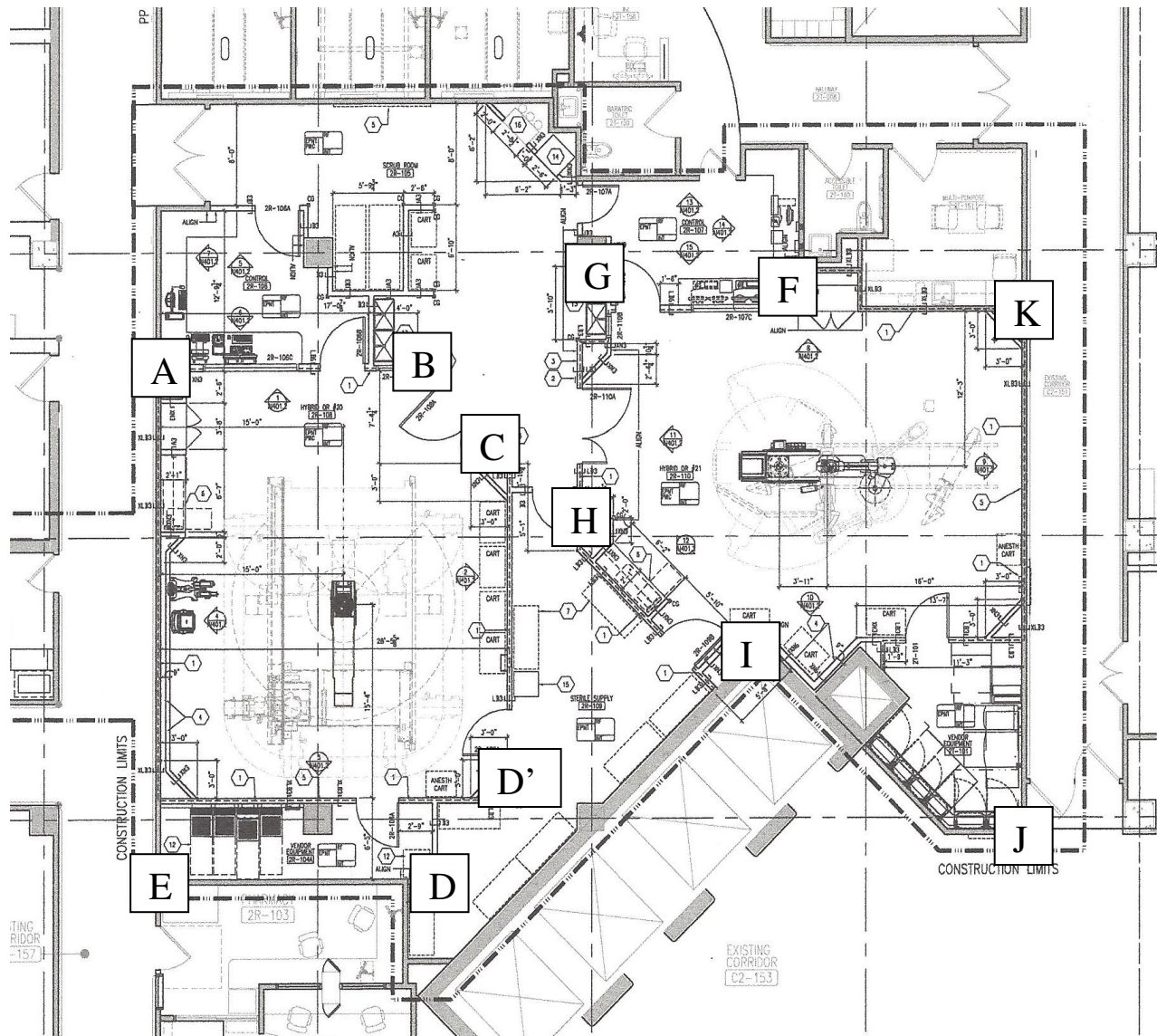
The Attenuation method was used for calculating the required TVL's to reduce the radiation levels to the designed radiation protection level. The material thickness' were calculated from the first TVL and subsequent equilibrium TVL's for the maximum photon energy used. A list of those parameters employed for the Workload, Maximum Photon Energy, Accelerator leakage and various materials are listed in above and included as an addendum to this report.

The implications of these basic criteria are that the specified dose per hour values shall not be exceeded during all normal hours of operation of the radiation sources. These values shall apply during the normal 40 hour work week for all areas which must be classed as "fully occupied."

## References

1. National Council on Radiation Protection and Measurements Report 147 "Structural Shielding Design for Medical X-ray Imaging Facilities.". Washington, D.C.: NCRP, NCRP Report No. 147; 2004.
2. National Council on Radiation Protection and Measurements. Radiation Protection Design Guidelines for 0.1-100 MeV particle Accelerator Facilities. Washington, D.C.: NCRP, NCRP Report No. 51; 1977.
3. McGinley, Patton H. Shielding Techniques for Radiation Oncology Facilities. Medical Physics Publishing; 1998.
4. Minnesota Department of Health (MDH) Ionizing Radiation Rules, Chapter 4732. The Office of Revisor of Statutes 7<sup>th</sup> Floor, State Office Building, St. Paul, MN 55155
5. Attenuation Properties of Diagnostic X-ray Shielding Materials, B.R. Archer et al, Medical Physics 21 (9), September 1994.
6. Boyer AL et al. Intensity Modulated Radiotherapy: Current Status and Issues of Interest, Int. J. Radiation Oncology Biol. Phys., Vol. 51, No. 4, 880-914, 2001

# Hybrid OR Room 20 and 21



EVEL FLOOR AND FINISH PLAN

<p>02-27-2014</p> <p>DATE</p>	<p><b>GENERAL NOTES:</b></p> <p>GENERAL CONTRACTOR AND/OR ALL SUBCONTRACTORS SHALL FIELD VERIFY ALL DIMENSIONS SHOWN ON THESE PLANS AND SHALL BE RESPONSIBLE FOR VARIATIONS BETWEEN PLAN DIMENSIONS AND ACTUAL FIELD DIMENSIONS. WHERE VARIATIONS ARE FOUND TO OCCUR, THE CONTRACTOR SHALL NOTIFY THE PROJECT ENGINEER IN WRITING PRIOR TO PROCEEDING WITH CONSTRUCTION; NO ADJUSTMENT TO THE WORK WILL BE MADE WITHOUT THE PRIOR APPROVAL OF THE PROJECT ENGINEER.</p> <p>GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR GENERAL DEMOLITION INCLUDING REMOVAL OF WALLS, PARTITIONS, DOORS &amp; CEILING &amp; FLOORS. ANY AND ALL CUTTING OF CONCRETE FLOORS, WALLS OR STRUCTURE SHALL BE THE GENERAL CONTRACTOR'S RESPONSIBILITY. CORE DRILLING THROUGH CONCRETE WALLS, FLOORS OR STRUCTURE FOR PIPING OR CONDUIT SHALL BE THE RESPONSIBILITY OF THE SUBCONTRACTOR BY TRADE. FIRESTOPPING OF THESE OPENINGS SHALL BE DONE BY THE RESPECTIVE SUBCONTRACTOR. REMOVAL OF DEBRIS RESULTING FROM DEMOLITION, CUTTING AND/OR DRILLING IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR. PATCHING AND REPAIR OF CONCRETE WALLS, FLOORS OR STRUCTURE SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR. THIS WILL BE ACCOMPLISHED UPON COMPLETION OF THE INSTALLATION OF ANY AND ALL UTILITIES INSTALLED BY THE VARIOUS SUBCONTRACTORS.</p>	<p><b>BWBR</b></p> <p>Lawson Commons 380 Saint Peter Street, Suite 600 Saint Paul, MN 55102-5690 651-222-3701</p>	<p>TRUE NORTH</p> <p>PLAN NORTH</p>	<p>I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATIONS OR ANY PART HEREOF, WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A duly LICENSED ARCHITECT. I AM THE USER OF THE SEALS OF THE STATE OF MINNESOTA. EXPIRATION DATE: 2020</p> <p>Drawing Scale 1" = 1'-0"</p> <p>Plot Scale 12" = 1'-0"</p>	<p>Drawing Title</p> <p><b>SECOND LEVEL, ARCHITECTURAL FLOOR AND FINISH PLAN</b></p> <p>Approved: Division Chief</p> <p>Approved: Service Director</p>
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Figure 1



**SECTION 21 05 11**  
**COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 21.
- B. Definitions:
  - 1. Exposed: Piping and equipment exposed to view in finished rooms.
  - 2. Option or optional: Contractor's choice of an alternate material or method.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Excavation and Backfill: Section 31 20 00, EARTH MOVING.
- D. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- G. Section 07 84 00, FIRESTOPPING.
- H. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- I. Section 07 92 00, JOINT SEALANTS.
- J. Section 09 91 00, PAINTING.
- L. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

**1.3 QUALITY ASSURANCE**

- A. Products Criteria:
  - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.
  - 2. Equipment Service: Products shall be supported by a service organization which maintains a complete inventory of repair parts and is located reasonably close to the site.
  - 3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  - 4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
  - 5. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on

equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

6. Asbestos products or equipment or materials containing asbestos shall not be used.

- B. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

C. Guarantee: In GENERAL CONDITIONS.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
1. Equipment and materials identification.
  2. Fire-stopping materials.
  3. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
  4. Wall, floor, and ceiling plates.
- C. Coordination Drawings: Provide details of the following.
1. Mechanical equipment rooms.
  2. Interstitial space.
  3. Hangers, inserts, supports, and bracing.
  4. Pipe sleeves.
  5. Equipment penetrations of floors, walls, ceilings, or roofs.
- D. Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
  2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment.

### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A36/A36M-2001.....Carbon Structural Steel
  - A575-96.....Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)
  - E84-2003.....Standard Test Method for Burning Characteristics of Building Materials
  - E119-2000.....Standard Test Method for Fire Tests of Building Construction and Materials
- C. National Fire Protection Association (NFPA):
  - 90A-96.....Installation of Air Conditioning and Ventilating Systems
  - 101-97.....Life Safety Code

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- D. Valve Tags and Lists:
  - 1. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm(1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
  - 2. Valve lists: Typed or printed plastic coated card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.

3. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

## **2.2 FIRESTOPPING**

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping.

## **2.3 GALVANIZED REPAIR COMPOUND**

Mil. Spec. DOD-P-21035B, paint form.

## **2.4 PIPE PENETRATIONS**

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
  1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
  2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
  3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from this requirement must receive prior approval of COR.
- D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.
- G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

- H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.
- I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

## **2.5 TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- D. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

## **2.6 WALL, FLOOR AND CEILING PLATES**

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Coordinate location of piping, sleeves, inserts, hangers, and equipment. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Protection and Cleaning:
  - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.
  - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly exposed materials and equipment.
- C. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Install gages, valves, and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- E. Work in Existing Building:
  - 1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
  - 2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
  - 3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type

- drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the COR. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the COR for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After COR's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.
- F. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.
- G. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
  2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

### **3.2 OPERATING AND PERFORMANCE TESTS**

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

### **3.3 INSTRUCTIONS TO VA PERSONNEL**

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

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**SECTION 21 13 13**  
**WET-PIPE SPRINKLER SYSTEMS**

**PART 1 - GENERAL**

**1.1 SCOPE OF WORK**

- A. Design, installation and testing shall be in accordance with NFPA 13 except for specified exceptions.
- B. The design and installation of a hydraulically calculated automatic wet system complete and ready for operation, for all affected portions of Building including the penthouse, mechanical equipment rooms, attic space, telephone rooms, elevator machine rooms, and elevator pits.
- C. Modification of the existing sprinkler system as indicated on the drawings and as further required by these specifications.

**1.2 RELATED WORK**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 07 84 00, FIRESTOPPING, Treatment of penetrations through rated enclosures.
- C. Section 21 05 11 COMMON WORK RESULTS FOR FIRE SUPPRESSION

**1.3 QUALITY ASSURANCE**

- A. Installer Reliability: The installer shall possess a valid State of Minnesota fire sprinkler contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.
- B. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL and approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA.
- C. Submittals: Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering. As Government review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial submittals will not be accepted. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and



provide index referencing the appropriate specification section.

Submittals shall include, but not be limited to, the following:

1. Qualifications:
  - a. Provide a copy of the installing contractor's fire sprinkler, and state, contractor's license.
  - b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering.
2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to NFPA 13. Include a site plan showing the piping to the water supply test location.
3. Manufacturers Data Sheets:
  - a. For backflow preventers, provide flow test curves from UL, FM, or the Foundation for Hydraulic Research and Cross-Connection Control to verify pressure loss calculations.
  - b. Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.
4. Calculation Sheets: Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of NFPA 13.
5. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

Submittals shall include, but not be limited to, the following:

  - a. One complete set of reproducible as-built drawings showing the installed system with the specific interconnections between the waterflow switch or pressure switch and the fire alarm equipment.
  - b. Complete, simple, understandable, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing all equipment, and a complete trouble shooting manual. Provide maintenance instructions on replacing any components of the system including internal parts, periodic cleaning and adjustment of the equipment and components with information as to the address and telephone number of both the manufacturer and the local supplier of each item.

- c. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13.
  - d. Certificates shall document all parts of the installation.
  - e. Instruction Manual: Provide one copy of the instruction manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser.
- D. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13. Recommendations in appendices shall be treated as requirements.
- 1. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.
  - 2. Sprinkler Protection: To determining spacing and sizing, apply the following coverage classifications:
    - a. Light Hazard Occupancies: Patient care, treatment, and customary access areas.
    - b. Ordinary Hazard Group 1 Occupancies: Laboratories, Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, Elevator Shafts, Elevator Machine Rooms, Refrigeration Service Rooms, Repair Shops.
    - c. Ordinary Hazard Group 2 Occupancies: Storage rooms, trash rooms, clean and soiled linen rooms, pharmacy and associated storage, laundry, kitchens, kitchen storage areas, retail stores, retail store storage rooms, storage areas, building management storage, boiler plants, energy centers, warehouse spaces, file storage areas for the entire area of the space up to 140 square meters (1500 square feet) and Supply Processing and Distribution (SPD).
    - d. Request clarification from the Government for any hazard classification not identified.
  - 3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.

5. Zoning:

- a. For each sprinkler zone provide a control valve, flow switch and a test and drain assembly with pressure gauge.
- b. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.

**1.4 APPLICABLE PUBLICATIONS**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):

13-2002.....Installation of Sprinkler Systems

101-22003.....Safety to Life from Fire in Buildings and  
Structures (Life Safety Code)

170-1999.....Fire Safety Symbols

SPEC WRITER NOTE: Specify the latest  
edition of the UL Fire Protection  
Equipment Directory.

C. Underwriters Laboratories, Inc. (UL):

Fire Protection Equipment Directory - 2001

SPEC WRITER NOTE: Specify the latest  
edition of the FM Approval Guide.

D. Factory Mutual Engineering Corporation (FM):

Approval Guide - 2001

E. Uniform Building Code - 1997

F. Foundation for Cross-Connection Control and Hydraulic Research-2005

**PART 2 PRODUCTS**

**2.1 PIPING & FITTINGS**

A. Sprinkler systems in accordance with NFPA 13. Use nonferrous piping in MRI Scanning Rooms.

1. All piping 2" and smaller shall be schedule 40 with screwed, or roll-grooved, fittings

2. Any piping 2.5" and larger may be provided as schedule 10 piping given that roll-grooved fittings are utilized.

3. Under no circumstances is thinwall piping acceptable for use within this facility.

B. Flexible Piping is not acceptable.

C. Saddles, strap on connections, and hot taps are not permitted.

## **2.2 VALVES**

- A. Valves in accordance with NFPA 13.
- B. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.
- C. The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI. (No Substitutions Allowed).
- D. Alarm valve shall be UL Listed and Factory Mutual Approved. The alarm valve shall be equipped with a removable cover assembly. The alarm valve shall be listed for installation in the vertical or horizontal position. The alarm valve shall be equipped with gauge connections on the system side and supply side of the valve clapper. The alarm valve shall be equipped with an external bypass to eliminate false water flow alarms. The alarm valve trim piping shall be externally galvanized. Maximum water working pressure to 250 PSI.

## **2.4 SPRINKLERS**

- A. Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval.
  - 1. Concealed heads will only be allowed within the Hybrid OR's to reduce risk of equipment striking the sprinkler body.
  - 2. All other areas to receive semi-recessed heads. Seal around ceiling penetration for areas with pressure relationship requirements.
- B. Temperature Ratings: In accordance with NFPA 13, except as follows:
  - 1. Sprinklers in imaging equipment room: Intermediate temperature rated.

## **2.5 SPRINKLER CABINET**

Provide sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each system. Locate adjacent to the riser. Sprinkler heads shall be installed in center of tile or center to center.

## **2.6 IDENTIFICATION SIGNS/HYDRAULIC PLACARDS**

Plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Enter pertinent data for each system on the hydraulic placard.

## **2.7 GAUGES**

Provide gauges as required by NFPA 13.

## **2.8 PIPE HANGERS AND SUPPORTS**

Supports, hangers, etc., of an approved pattern placement to conform to NFPA 13. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in NFPA 13, Standard for Installation of Sprinkler Systems. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application. Hangers or supports not specifically listed for service shall be designed and bear the seal of a professional engineer.

## **2.9 WALL, FLOOR AND CEILING PLATES**

Provide chrome plated steel escutcheon plates for exposed piping passing through walls, floors or ceilings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.
- B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Install concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, such as in operating and radiology rooms, install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. Locate piping in stairways as near to the ceiling as possible to prevent tampering by unauthorized personnel, and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.
- C. Welding: Conform to the requirements and recommendations of NFPA 13.
- D. Drains: Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13.
- E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.

- F. Waterflow Alarm Switches: Install waterflow switch and adjacent valves in easily accessible locations.
- G. Inspector's Test Connection: Install and supply in conformance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.
- H. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.
- I. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.
- J. Provide pressure gauge at each water flow alarm switch location and at each main drain connection.
- K. For each fire department connection, provide the symbolic sign given in NFPA 170 and locate 2400 to 3000 mm (8 to 10 feet) above each connection location. Size the sign to 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).
- L. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.
- M. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.
- N. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.
- O. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the COR. Contractor shall develop an interim fire protection program where interruptions involve in occupied spaces. Request in writing at least one week prior to the planned interruption.

### **3.2 INSPECTION AND TEST**

- A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in

the presence of the COR or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.

- B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COR to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

### **3.3 INSTRUCTIONS**

Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COR.

- - - E N D - - -

**SECTION 22 05 11  
COMMON WORK RESULTS FOR PLUMBING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section shall apply to all sections of Division 22.
- B. Definitions:
  - 1. Exposed: Piping and equipment exposed to view in finished rooms.
  - 2. Option or optional: Contractor's choice of an alternate material or method.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 07 84 00, FIRESTOPPING.
- D. Section 22 07 11, PLUMBING INSULATION.

**1.3 QUALITY ASSURANCE**

- A. Products Criteria:
  - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
  - 2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, critical instrumentation, computer workstation and



- programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
  4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the COR.
  5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
  7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
  8. Asbestos products or equipment or materials containing asbestos shall not be used.
- B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
  2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
  3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

4. All welds shall be stamped according to the provisions of the American Welding Society.
- C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- D. Execution (Installation, Construction) Quality:
  1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract drawings and specifications shall be referred to the COR for resolution. Written hard copies or computer files of manufacturer's installation instructions shall be provided to the COR at least two weeks prior to commencing installation of any item.
  2. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved.
- F. Plumbing Systems: IPC, International Plumbing Code.

#### **1.4 SUBMITTALS**

- A. Submittals shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.
- C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

- E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Upon request by Government, lists of previous installations for selected items of equipment shall be provided. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
  2. Equipment and materials identification.
  3. Fire stopping materials.
  4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
  5. Wall, floor, and ceiling plates.
- H. Coordination Drawings: In accordance with GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION. Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping until layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.
1. Mechanical equipment rooms.

2. Interstitial space.
3. Hangers, inserts, supports, and bracing.
4. Pipe sleeves.
5. Equipment penetrations of floors, walls, ceilings, or roofs.

I. Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided.
3. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

**1.5 DELIVERY, STORAGE AND HANDLING**

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost to the Government.
3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.

2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC), latest edition. All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):  
Boiler and Pressure Vessel Code (BPVC):  
SEC IX-2007.....Boiler and Pressure Vessel Code; Section IX,  
Welding and Brazing Qualifications.
- C. American Society for Testing and Materials (ASTM):  
A36/A36M-2008.....Standard Specification for Carbon Structural  
Steel  
A575-96 (R 2007).....Standard Specification for Steel Bars, Carbon,  
Merchant Quality, M-Grades R (2002)  
E84-2005.....Standard Test Method for Surface Burning  
Characteristics of Building Materials  
E119-2008a.....Standard Test Methods for Fire Tests of  
Building Construction and Materials
- D. Manufacturers Standardization Society (MSS) of the Valve and Fittings  
Industry, Inc:  
SP-58-02.....Pipe Hangers and Supports-Materials, Design and  
Manufacture  
SP 69-2003 (R 2004).....Pipe Hangers and Supports-Selection and  
Application
- E. National Electrical Manufacturers Association (NEMA):  
MG1-2003, Rev. 1-2007...Motors and Generators
- C. International Code Council, (ICC):

IBC-06, (R 2007).....International Building Code  
IPC-06, (R 2007).....International Plumbing Code

## **PART 2 - PRODUCTS**

### **2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. STANDARDIZATION OF COMPONENTS SHALL BE MAXIMIZED TO REDUCE SPARE PART requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
  - 1. All components of an assembled unit need not be products of same manufacturer.
  - 2. Constituent parts that are alike shall be products of a single manufacturer.
  - 3. Components shall be compatible with each other and with the total assembly for intended service.
  - 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, shall be the same make and model

### **2.2 COMPATIBILITY OF RELATED EQUIPMENT**

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

### **2.3 SAFETY GUARDS**

- A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 6 mm (1/4-inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

B. All Equipment shall have moving parts protected from personal injury.

#### **2.4 LIFTING ATTACHMENTS**

Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

#### **2.5 EQUIPMENT AND MATERIALS IDENTIFICATION**

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, fans, etc. shall be identified.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.
- D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
  - 1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
  - 2. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm(1/4-inch) for service designation on 19 gage, 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
  - 3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) shall show valve tag number, valve function and area of

control for each service or system. The valve list shall be in a punched 3-ring binder notebook. A copy of the valve list shall be mounted in picture frames for mounting to a wall.

4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling.

## **2.6 FIRE STOPPING**

- A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION, for pipe insulation.

## **2.7 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

- A. The Support system of suspended equipment over 227 kg (500 pounds) shall be submitted for approval of the COR in all cases. See these specifications for lateral force design requirements.
- B. Type Numbers Specified: MSS SP-58. For selection and application refer to MSS SP-69.
- C. For Attachment to Concrete Construction:
  1. Concrete insert: Type 18, MSS SP-58.
  2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (4 inches) thick when approved by the COR for each job condition.
  3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (4 inches) thick when approved by the COR for each job condition.
- D. For Attachment to Steel Construction: MSS SP-58.
  1. Welded attachment: Type 22.
  2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8-inch) outside diameter.
- E. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.



- F. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Trapeze hangers are not permitted for steam supply and condensate piping.
1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
  2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13 mm (1/2-inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- G. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
1. General Types (MSS SP-58):
    - a. Standard clevis hanger: Type 1; provide locknut.
    - b. Riser clamps: Type 8.
    - c. Wall brackets: Types 31, 32 or 33.
    - d. Roller supports: Type 41, 43, 44 and 46.
    - e. Saddle support: Type 36, 37 or 38.
    - f. Turnbuckle: Types 13 or 15.
    - g. U-bolt clamp: Type 24.
    - h. Copper Tube:
      - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with isolation tape to prevent electrolysis.
      - 2) For vertical runs use epoxy painted or plastic coated riser clamps.

- 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
- 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
- j. Spring hangers are required on all plumbing system pumps one horsepower and greater.
- 2. Plumbing Piping (Other Than General Types):
  - a. Horizontal piping: Type 1, 5, 7, 9, and 10.
  - b. Chrome plated piping: Chrome plated supports.
  - c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
  - d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.
- H. Pre-insulated Calcium Silicate Shields:
  - 1. Provide 360 degree water resistant high density 965 kPa (140 psi) compressive strength calcium silicate shields encased in galvanized metal.
  - 2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
  - 3. Shield thickness shall match the pipe insulation.
  - 4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
    - a. Shields for supporting cold water shall have insulation that extends a minimum of one inch past the sheet metal.
    - b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psi) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.

5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

## **2.8 PIPE PENETRATIONS**

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all fire stopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
  1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
  2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
  3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COR.
- D. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
- F. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel Sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- G. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.

H. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

I. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

## **2.9 TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- D. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

## **2.10 WALL, FLOOR AND CEILING PLATES**

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3 inch) pipe, 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

## **2.11 ASBESTOS**

Materials containing asbestos are not permitted.

### **PART 3 - EXECUTION**

#### **3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING**

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.

Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.

C. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.

D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

E. Cutting Holes:

1. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.
2. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.

3. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.
  2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- I. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE. shall be used for all pad or floor mounted equipment. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- J. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control

devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.

- K. Many plumbing systems interface with the HVAC control system. See the HVAC control points list and section 23 09 23 DIRECT DIGITAL CONTROLS FOR HVAC
- L. Work in Existing Building:
1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
  2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.
- M. Work in Animal Research Areas: Seal all pipe penetrations with silicone sealant to prevent entrance of insects.
- N. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.
- O. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.
- P. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
  2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

### **3.2 TEMPORARY PIPING AND EQUIPMENT**

- A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary

equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.

- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Para. 3.1 shall apply.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

### **3.3 PIPE AND EQUIPMENT SUPPORTS**

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the COR.
- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.
- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work shall be provided.
- D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC), latest edition, and these specifications.
- E. Overhead Supports:
  - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
  - 2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
  - 3. Tubing and capillary systems shall be supported in channel troughs.



F. Floor Supports:

1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.

**3.4 LUBRICATION**

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
- B. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered to CO in unopened containers that are properly identified as to application.
- C. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
- E. All lubrication points shall be extended to one side of the equipment.

**3.5 PLUMBING SYSTEMS DEMOLITION**

- A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the CO. Such access shall be provided without additional cost or time to the Government. Where

work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.

- B. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards. Inspections will be made by personnel of the VA Medical Center, and the Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications.

Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

### **3.6 CLEANING**

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned.
- B. In addition, the following special conditions apply:
  - 1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
  - 2. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint obtained from manufacturer or computer matched.

### **3.7 IDENTIFICATION SIGNS**

- A. Laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.

### **3.8 STARTUP AND TEMPORARY OPERATION**

- A. Start up of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

### **3.9 OPERATING AND PERFORMANCE TESTS**

- A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of

tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.

- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests such systems respectively during first actual seasonal use of respective systems following completion of work.

### **3.10 OPERATION AND MAINTENANCE MANUALS**

- A. Provide four bound copies. The Operations and maintenance manuals shall be delivered to COR not less than 30 days prior to completion of a phase or final inspection.
- B. All new and temporary equipment and all elements of each assembly shall be included.
- C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- D. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.
- E. Lubrication instructions, type and quantity of lubricant shall be included.
- F. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
- G. Set points of all interlock devices shall be listed.
- H. Trouble-shooting guide for the control system troubleshooting guide shall be inserted into the Operations and Maintenance Manual.

### **3.11 INSTRUCTIONS TO VA PERSONNEL**

Instructions shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

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**SECTION 22 05 19**

**METERS AND GAGES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section describes the requirements for pressure gages.

**1.2 RELATED WORK**

Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Pressure Gages.
- C. Operations and Maintenance manual shall include:
  - 1. System Description
  - 2. Major assembly block diagrams
  - 3. Troubleshooting and preventive maintenance guidelines
  - 4. Spare parts information.
- D. Shop Drawings shall include the following:
  - 1. One line, wiring and terminal diagrams including terminals identified, protocol or communication modules, and Ethernet connections.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):
  - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
  - B40.1-05.....Gauges-Pressure Indicating Dial Type-Elastic
- C. American Water Works Association (AWWA):
  - C700-07 (R 2003).....Standard for Cold Water Meters, Displacement Type, Bronze Main Case
  - C701-07.....Cold Water Meters-Turbine Type, for Customer Service AWWA/ ANSI
  - C702-01.....Cold water meters - Compound Type

D. International Code Council (ICC):

IPC-06.....(2007 Supplement) International Plumbing Code

**1.5 AS-BUILT DOCUMENTATION**

- A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended."
- B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of operation and maintenance data updated to include submittal review comments shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

**PART 2 - PRODUCTS**

**2.7 PRESSURE GAGES FOR WATER AND SEWAGE USAGE**

- A. ANSI B40.1 all metal case 114 mm (4-1/2 inches) diameter, bottom connected throughout, graduated as required for service, and identity labeled. Range shall be 0 to 1375 kPa (0 to 200 psi) gauge.

- B. The pressure element assembly shall be bourdon tube. The mechanical movement shall be lined to pressure element and connected to pointer.
- C. The dial shall be non-reflective aluminum with permanently etched scale markings graduated in kPa and psi.
- D. The pointer shall be dark colored metal.
- E. The window shall be glass.
- F. The ring shall be brass or stainless steel.
- G. The accuracy shall be grade A, plus or minus 1 percent of middle half of scale range.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Direct mounted pressure gages shall be installed in piping tees with pressure gage located on pipe at the most readable position.
- B. Valves and snubbers shall be installed in piping for each pressure gage.
- C. Test plugs shall be installed on the inlet and outlet pipes all heat exchangers or water heaters serving more than one plumbing fixture.
- D. Pressure gages shall be installed where indicated on the drawings and at the following locations:
  - 1. Building water service entrance into building
  - 2. Inlet and outlet of each pressure reducing valve
  - 3. Suction and discharge of each domestic water pump or re-circulating hot water return pump.

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**SECTION 22 05 23**  
**GENERAL-DUTY VALVES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.

**1.2 RELATED WORK**

- A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
1. Valves.
  2. Backflow Preventers.
  3. Pressure Reducing Valves.
  4. Backwater Valves5. All items listed in Part 2 - Products.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):A536-84(R 2004)  
Standard Specification for Ductile Iron Castings
- C. American Society of Sanitary Engineering (ASSE)  
ASSE 1003-01 (R 2003)...Performance Requirements for Water Pressure  
Reducing Valves  
ASSE 1012-02.....Backflow Preventer with Intermediate  
Atmospheric Vent  
ASSE 1013-05.....Reduced Pressure Principle Backflow Preventers  
and Reduced Pressure Fire Protection Principle  
Backflow Preventers
- D. International Code Council (ICC)  
IPC-06 (R 2007).....International Plumbing Code
- E. Manufacturers Standardization Society of the Valve and Fittings  
Industry, Inc. (MSS):



SP-25-98.....Standard Marking System for Valves, Fittings,  
Flanges and UnionsSP-67-02a (R 2004) Butterfly  
Valve of the Single flange Type (Lug Wafer)  
SP-70-06.....Cast Iron Gate Valves, Flanged and Threaded  
Ends.  
SP-72-99.....Ball Valves With Flanged or Butt Welding For  
General Purpose  
SP-80-03.....Bronze Gate, Globe, Angle and Check Valves.  
SP-110-96.....Ball Valve Threaded, Socket Welding, Solder  
Joint, Grooved and Flared Ends

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Valves shall be prepared for shipping as follows:
1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, grooves, and weld ends.
  3. Set angle, gate, and globe valves closed to prevent rattling.
  4. Set ball and plug valves open to minimize exposure of functional surfaces
  5. Set butterfly valves closed or slightly open.
  6. Block check valves in either closed or open position.
- B. Valves shall be prepared for storage as follows:
1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher than ambient dew point temperature.
- C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

### **PART 2 - PRODUCTS**

#### **2.1 VALVES**

- A. Asbestos packing and gaskets are prohibited.
- B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.
- C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or

disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.

- D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 meters (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
- E. Ball valves, pressure regulating valves, gate valves, globe valves, and plug valves used to supply potable water shall meet the requirements of NSF 61.

F. Shut-off:

1. Cold, Hot and Re-circulating Hot Water:

- a. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-72, SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4140 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be solder,
- b. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A 536, ductile iron.

C. Balancing:

- 1. Hot Water Re-circulating, 80 mm or DN80 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4" NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

D. Check:

1. Check valves less than 80 mm or DN80 (3 inches) and smaller) shall be class 125, bronze swing check valves with non metallic Buna-N disc. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B 62, solder joints, and PTFE or TFE disc.

## **2.2 BACKFLOW PREVENTERS**

- A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. The backflow prevention assembly shall be ASSE 1013 listed and certified.
- B. Reduced pressure backflow preventers shall be installed in the following applications.
  1. Sterilizers.
  2. Dialysis, Deionized or Reverse Osmosis Water Systems.
- C. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port valves and an integral relief. Manufacturer to be Apollo Conbraco or Watts Regulator.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.
- D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### **3.2 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.
- C. Valves shall be installed in horizontal piping with stem at or above center of pipe
- D. Valves shall be installed in a position to allow full stem movement.
- E. Check valves shall be installed for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.

### **3.3 ADJUSTING**

- A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves shall be replaced if persistent leaking occurs.

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**SECTION 22 07 11  
PLUMBING INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Field applied insulation for thermal efficiency and condensation control for
  - 1. Plumbing piping and equipment.
  - 2. Re-insulation of plumbing piping and equipment if damage caused during construction.
- B. Definitions
  - 1. ASJ: All service jacket, white finish facing or jacket.
  - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
  - 3. Cold: Equipment or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
  - 4. Concealed: Piping above ceilings and in chases, interstitial space, and pipe spaces.
  - 5. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
  - 6. FSK: Foil-scrim-kraft facing.
  - 7. Hot: Plumbing equipment or piping handling media above 41 degrees C (105 degrees F).
  - 8. Density:  $\text{kg/m}^3$  - kilograms per cubic meter (Pcf - pounds per cubic foot).
  - 9. Thermal conductance: Heat flow rate through materials.
    - a. Flat surface: Watts per square meter (BTU per hour per square foot).
    - b. Pipe or Cylinder: Watts per square meter (BTU per hour per linear foot).
  - 10. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
  - 11. Vapor Retarder (Vapor Barrier): A material which retards the

transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.

- 12. R: Pump recirculation.
- 13. CW: Cold water.
- 14. SW: Soft water.
- 15. HW: Hot water.
- 16. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

## **1.2 RELATED WORK**

- A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
- B. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING and Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.

## **1.3 QUALITY ASSURANCE**

- A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

- B. Criteria:

- 1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

- 4.3.3.1** Pipe insulation and coverings, vapor retarder facings, adhesives, fasteners, tapes, unless otherwise provided for in 4.3.3.1.12 or 4.3.3.1.2, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

- 4.3.3.1.1** Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2.)

- 4.3.3.3** Pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test

for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.10.2.6.3 Nonferrous fire sprinkler piping shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

4.3.10.2.6.7 Smoke detectors shall not be required to meet the provisions of this section.

2. Test methods: ASTM E84, UL 723, or NFPA 255.

3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

#### **1.4 SUBMITTALS**

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.

a. Insulation materials: Specify each type used and state surface burning characteristics.

- b. Insulation facings and jackets: Each type used.
  - c. Insulation accessory materials: Each type used.
  - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
  - e. Make reference to applicable specification paragraph numbers for coordination.
- C. Samples:
- 1. Each type of insulation: Minimum size 100 mm (4 inches) square for board/block/ blanket; 150 mm (6 inches) long, full diameter for round types.
  - 2. Each type of facing and jacket: Minimum size 100 mm (4 inches square).
  - 3. Each accessory material: Minimum 120 ML (4 ounce) liquid container or 120 gram (4 ounce) dry weight for adhesives / cement / mastic. //

#### **1.5 STORAGE AND HANDLING OF MATERIAL**

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):  
L-P-535E (2)-91.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. Military Specifications (Mil. Spec.):  
MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation  
MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic Thermal Insulation  
MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier



MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread,  
Glass and Wire-Reinforced Glass

D. American Society for Testing and Materials (ASTM):

A167-04 .....Standard Specification for Stainless and  
Heat-Resisting Chromium-Nickel Steel Plate,  
Sheet, and Strip

B209-07.....Standard Specification for Aluminum and  
Aluminum-Alloy Sheet and Plate

C411-05.....Standard test method for Hot-Surface  
Performance of High-Temperature Thermal  
Insulation

C449-07.....Standard Specification for Mineral Fiber  
Hydraulic-Setting Thermal Insulating and  
Finishing Cement

C533-09.....Standard Specification for Calcium Silicate  
Block and Pipe Thermal Insulation

C534-08 .....Standard Specification for Preformed Flexible  
Elastomeric Cellular Thermal Insulation in  
Sheet and Tubular Form

C547-07 .....Standard Specification for Mineral Fiber pipe  
Insulation

C552-07 .....Standard Specification for Cellular Glass  
Thermal Insulation

C553-08 .....Standard Specification for Mineral Fiber  
Blanket Thermal Insulation for Commercial and  
Industrial Applications

C585-09.....Standard Practice for Inner and Outer Diameters  
of Rigid Thermal Insulation for Nominal Sizes  
of Pipe and Tubing (NPS System) R (1998)

C612-10 .....Standard Specification for Mineral Fiber Block  
and Board Thermal Insulation

C1126-10.....Standard Specification for Faced or Unfaced  
Rigid Cellular Phenolic Thermal Insulation

- C1136-10 .....Standard Specification for Flexible, Low  
Permeance Vapor Retarders for Thermal  
Insulation
- D1668-97a (2006).....Standard Specification for Glass Fabrics (Woven  
and Treated) for Roofing and Waterproofing
- E84-10 .....Standard Test Method for Surface Burning  
Characteristics of Building  
Materials
- E119-09C.....Standard Test Method for Fire Tests of Building  
Construction and Materials
- E136-09 b.....Standard Test Methods for Behavior of Materials  
in a Vertical Tube Furnace at 750 degrees C  
(1380 F)
- E. National Fire Protection Association (NFPA):
- 101-09 .....Life Safety Code
- 251-06.....Standard methods of Tests of Fire Endurance of  
Building Construction Materials
- 255-06.....Standard Method of tests of Surface Burning  
Characteristics of Building Materials
- F. Underwriters Laboratories, Inc (UL):
- 723.....UL Standard for Safety Test for Surface Burning  
Characteristics of Building Materials with  
Revision of 08/03
- G. Manufacturer's Standardization Society of the Valve and Fitting  
Industry (MSS):
- SP58-2002.....Pipe Hangers and Supports Materials, Design,  
and Manufacture

## **PART 2 - PRODUCTS**

### **2.1 TECHLITE ISULATION OR APPROVED EQUAL (NOTE: THIS WAS PREVIOUSLY SHOWN AS BID OPTION #7 FOR PHASE 1 SCOPE - NOW CONSIDERED AS BASE BID FOR PHASE 2)**

- A. Preformed (molded) flexible open cell melamine pipe insulation, ASTM C-  
1410, for temperatures between -40 degrees F and 350 degrees F.  
Include 4 oz kraft paper/foil laminate service jacket with fiberglass

reinforcement. Mechanical Contractor to include within base bid pricing for this product to be utilized on all domestic hot and cold water piping associated with new installations.

- B. Thermal Conductivity: 0.25" btu per in/hr\*ft<sup>2</sup>
- C. Density: 0.56 +/- 0.06 lb/ft<sup>3</sup>
- D. Flame spread/Smoke development: 25/50 per ASTM E84

## 2.2 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.

## 2.3 PIPE COVERING PROTECTION SADDLES

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m<sup>3</sup> (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m<sup>3</sup> (3.0 pcf).

#### **2.4 FLAME AND SMOKE**

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

### **PART 3 - EXECUTION**

#### **3.1 GENERAL REQUIREMENTS**

- A. Required pressure tests of piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- D. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- E. Plumbing work not to be insulated:
1. Piping and valves of fire protection system.
  2. Chromium plated brass piping.
  3. Water piping in contact with earth.
  4. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).

- F. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- G. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights.  
Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- H. Firestop Pipe insulation:
  - 1. Provide firestopping insulation at fire and smoke barriers through penetrations.
  - 2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
    - a. Pipe risers through floors
    - b. Pipe chase walls and floors
    - c. Smoke partitions
    - d. Fire partitions

### **3.2 INSULATION INSTALLATION**

- A. Molded Mineral Fiber Pipe and Tubing Covering:
  - 1. Fit insulation to pipe, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
  - 2. Contractor's options for fitting, flange and valve insulation:
    - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
    - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal

seam edges with vapor barrier mastic and secure with fitting tape.

- c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
  - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

#### 3.4 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature Range/Service	Insulation Material	Less than 25 (1)	25 - 32 (1 - 1¼)	38 - 75 (1½ - 3)	100 (4) and Above
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Techlite Insulation (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
4-16 degrees C (40-60 degrees F) (Domestic Cold Water)	Techlite Insulation (Above ground piping only)	25 (1.0)	25 (1.0)	25 (1.0)	25 (1.0)

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**SECTION 22 11 00**  
**FACILITY WATER DISTRIBUTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

**1.2 RELATED WORK**

- A. Penetrations in rated enclosures: Section 07 84 00, FIRESTOPPING.
- B. Preparation and finish painting and identification of piping systems: Section 09 91 00, PAINTING.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Pipe Insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Piping.
  - 2. Strainers.
  - 3. All items listed in Part 2 - Products.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
  - A-A-1427C.....Sodium Hypochlorite Solution
  - A-A-59617.....Unions, Brass or Bronze Threaded, Pipe Connections and Solder-Joint Tube Connections
- C. American National Standards Institute (ANSI):
  - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
  - A13.1-96.....Scheme for Identification of Piping Systems
  - B16.3-98.....Malleable Iron Threaded Fittings ANSI/ASME
  - B16.4-98.....Cast Iron Threaded Fittings Classes 125 and 250 ANSI/ASME
  - B16.9-01.....Factory-Made Wrought Steel Buttwelding Fittings ANSI/ASME

- B16.11-01.....Forged Steel Fittings, Socket-Welding and  
Threaded ANSI/ASME
- B16.12-98.....Cast Iron Threaded Drainage Fittings ANSI/ASME
- B16.15-85(R 1994).....Cast Bronze Threaded Fittings ANSI/ASME
- B16.18-01.....Cast Copper Alloy Solder-Joint Pressure  
Fittings ANSI/ASME
- B16.22-01.....Wrought Copper and Copper Alloy Solder Joint  
Pressure Fittings ANSI/ASME  
Element ANSI/ASME
- D. American Society for Testing and Materials (ASTM):
- A47-99.....Ferritic Malleable Iron Castings Revision 1989
- A53-02.....Pipe, Steel, Black And Hot-Dipped, Zinc-coated  
Welded and Seamless
- A74-03.....Cast Iron Soil Pipe and Fittings
- B32-03.....Solder Metal
- B61-02.....Steam or Bronze Castings
- B62-02.....Composition Bronze or Ounce Metal Castings
- B75-99(Rev A).....Seamless Copper Tube
- B88-03.....Seamless Copper Water Tube
- B584-00.....Copper Alloy Sand Castings for General  
Applications Revision A
- C564-03.....Rubber Gaskets for Cast Iron Soil Pipe and  
Fittings
- E1120.....Standard Specification For Liquid Chlorine
- E. American Water Works Association (AWWA):
- C110-03/ A21.10-03.....Ductile Iron and Gray Iron Fittings - 75 mm  
thru 1200 mm (3 inch thru 48 inches) for Water  
and other liquids AWWA/ ANSI
- C151-00/ A21.51-02.....Ductile-Iron Pipe, Centrifugally Cast in Metal  
Molds or Sand-Lined Molds, for Water or Other  
Liquids AWWA/ ANSI
- C651-99.....Disinfecting Water Mains
- F. American Welding Society (AWS):
- A5.8-92.....Filler Metals for Brazing
- G. National Association of Plumbing - Heating - Cooling Contractors  
(PHCC):



National Standard Plumbing Code - 1996

H. International Association of Plumbing and Mechanical Officials (IAPMO):  
Uniform Plumbing Code - 2000

IS6-93.....Installation Standard

I. Manufacturers Standardization Society of the Valve and Fittings  
Industry, Inc. (MSS):

SP-72-99.....Ball Valves With Flanged or Butt Welding For  
General Purpose

SP-110-96.....Ball Valve Threaded, Socket Welding, Solder  
Joint, Grooved and Flared Ends

J. American Society of Sanitary Engineers (ASSE):

1001-02.....Pipe Applied Atmospheric Type Vacuum Breakers

1018-01.....Performance for trap seal primer valve-water  
supply fed

1020-04.....Vacuum Breakers, Anti-Siphon, Pressure Type

K. Plumbing and Drainage Institute (PDI):

PDI WH-201.....Water Hammer Arrestor

## **PART 2 - PRODUCTS**

### **2.1 INTERIOR DOMESTIC WATER PIPING**

A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless, steel ASTM A312, schedule 10 may be used.

B. Fittings for Copper Tube:

1. Wrought copper or bronze castings conforming to ANSI B16.18 and B16.22. Unions shall be bronze, MSS SP72 & SP 110, Solder or braze joints.

2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75 C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, CDA 844. Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or malleable iron, ASTM A47 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.

3. Mechanically formed tee connection: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device

shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting. Braze joints.

- C. Adapters: Provide adapters for joining screwed pipe to copper tubing.
- D. Solder: ASTM B32 Composition Sb5 HA or HB. Provide non-corrosive flux.
- E. Brazing alloy: AWS A5.8, Classification BCuP.

## **2.2 EXPOSED WATER PIPING**

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
  - 1. Pipe: Fed. Spec. WW-P-351, standard weight.
  - 2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
  - 3. Nipples: ASTM B 687, Chromium-plated.
  - 4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
- B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Comply with the PHCC National Standard Plumbing Code and the following:
  - 1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
  - 2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
  - 3. All pipe runs shall be laid out to avoid interference with other work.
  - 4. Install union and shut-off valve on pressure piping at connections to equipment.

5. Pipe Hangers, Supports and Accessories:
  - a. All piping shall be supported per of the National Standard Plumbing Code, Chapter No. 8.
  - b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with red lead or zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
  - c. Floor, Wall and Ceiling Plates, Supports, Hangers:
    - 1) Solid or split unplated cast iron.
    - 2) All plates shall be provided with set screws.
    - 3) Pipe Hangers: Height adjustable clevis type.
    - 4) Adjustable Floor Rests and Base Flanges: Steel.
    - 5) Concrete Inserts: "Universal" or continuous slotted type.
    - 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
    - 7) Riser Clamps: Malleable iron or steel.
    - 8) Rollers: Cast iron.
    - 9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
    - 10) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.
    - 11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
6. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:
  - a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that

provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

Completely fill and seal clearances between raceways and openings with the fire stopping materials.

- b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- B. Piping shall conform to the following:
- 1. Domestic Water:
    - a. Where possible, grade all lines to facilitate drainage. Provide drain valves at bottom of risers. All unnecessary traps in circulating lines shall be avoided.
    - b. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

### 3.2 TESTS

- A. General: Test system either in its entirety or in sections.
- B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 690 kPa (100 psi) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested.
- C. All Other Piping Tests: Test new installed piping under 1 1/2 times actual operating conditions and prove tight.

### 3.3 STERILIZATION

- A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.
- B. Use either liquid chlorine for sterilization.

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**SECTION 22 13 00**  
**FACILITY SANITARY AND VENT PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

**1.2 RELATED WORK**

- A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- B. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.
- C. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Pipe Insulation.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Piping.
  - 2. Floor Drains.
  - 3. Grease Removal Unit.
  - 4. Cleanouts.
  - 5. All items listed in Part 2 - Products.
- C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME): (Copyrighted Society)
  - A112.6.3-01 (R 2007)....Standard for Floor and Trench Drains
  - A13.1-07.....Scheme for Identification of Piping Systems
  - B16.3-06.....Malleable Iron Threaded Fittings, Classes 150 and 300.
  - B16.4-06.....Standard for Grey Iron Threaded Fittings  
Classes 125 and 250
  - B16.12-98 (R 2006).....Cast Iron Threaded Drainage Fittings

B16.15-06.....Cast Bronze Threaded Fittings, Classes 125 and  
250

C. American Society for Testing and Materials (ASTM):

A74-06.....Standard Specification for Cast Iron Soil Pipe  
and Fittings

A536-84(R 2004).....Standard Specification for Ductile Iron  
Castings

B584-06a.....Standard Specification for Copper Alloy Sand  
Castings for General Applications

C564-03a.....Standard Specification for Rubber Gaskets for  
Cast Iron Soil Pipe and Fittings

D. International Code Council:

IPC-06.....International Plumbing Code

E. Cast Iron Soil Pipe Institute (CISPI):

301-05.....Hubless Cast Iron Soil Pipe and Fittings for  
Sanitary and Storm Drain, Waste, and Vent  
Piping Applications

310-04.....Coupling for Use in Connection with Hubless  
Cast Iron Soil Pipe and Fittings for Sanitary  
and Storm Drain, Waste, and Vent Piping  
Applications

F. Plumbing and Drainage Institute (PDI):

PDI WH-201.....Water Hammer Arrestor

**PART 2 - PRODUCTS**

**2.1 SANITARY WASTE, DRAIN, AND VENT PIPING**

A. Cast iron waste, drain, and vent pipe and fittings

1. Cast iron waste, drain, and vent pipe and fittings shall be used for  
the following applications:

a. interior waste and vent piping above grade.

2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-  
hub or hubless).

3. The material for all pipe and fittings shall be cast iron soil pipe  
and fittings and shall conform to the requirements of CISPI Standard  
301, ASTM A-888, or ASTM A-74.

4. Joints for hubless pipe and fittings shall conform to the  
manufacturer's installation instructions. Couplings for hubless

joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM Standard C-564 or be installed with lead and oakum.

## **2.2 EXPOSED WASTE PIPING**

- A. Full iron pipe size chrome plated brass piping shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
1. The Pipe shall meet Fed. Spec. WW-P-351, standard weight.
  2. The Fittings shall conform to ANSI B16.15, cast bronze threaded fittings with chrome finish, (125 and 250).
  3. Nipples shall conform to ASTM B 687, Chromium-plated.
  4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
- B. In unfinished Rooms such as mechanical Rooms and Kitchens, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph "Sanitary Waste, Drain, and Vent Piping" can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 91 00, PAINTING.

## **2.3 SPECIALTY PIPE FITTINGS**

- A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
- B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 860 kPa (125 psig) at a minimum temperature of 82°C (180°F). The end connection shall be solder joint copper alloy and threaded ferrous.

- C. Dielectric flange insulating kits shall be of non conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.
- D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F 1545 with a pressure ratings of 2070 kPa (300 psig) at 107°C (225°F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

#### **2.4 CLEANOUTS**

- A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.
- B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.
- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of



sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

## **2.5 FLOOR DRAINS**

- A. Type A (FD-A) floor drain shall comply with ANSI A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening will not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a 2.2 kg (16-ounce) soft copper membrane, 600 mm (24 inches) square or another approved waterproof membrane shall be provided.

## **2.6 TRAPS**

- A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as pipe connected to. Slip joints are not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

### **PART 3 - EXECUTION**

#### **3.1 PIPE INSTALLATION**

- A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.
- B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings where possible.
- F. The piping shall be installed to permit valve servicing or operation.
- G. Unless specifically indicated on the drawings, the minimum slope shall be 2% slope.
- H. The piping shall be installed free of sags and bends.
- I. Seismic restraint shall be installed where required by code.
- J. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- L. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"

- M. Aboveground copper tubing shall be installed according to CDA's "Copper Tube Handbook".

### **3.2 JOINT CONSTRUCTION**

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service
  2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.

### **3.3 SPECIALTY PIPE FITTINGS**

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

### **3.3 PIPE HANGERS, SUPPORTS AND ACCESSORIES:**

- A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.

- B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
  2. 80 mm or DN 80 (NPS 3 inch): 1500 mm (60 inches) with 13 mm (½ inch) rod.
  3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 to NPS 5): 1500 mm (60 inches) with 16 mm (5/8 inch) rod.
  4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 19 mm (¾ inch) rod.
  5. 250 mm or DN250 to 300 mm or DN 300 (NPS 10 inch to NPS 12 inch): 1500 mm (60 inch) with 22 mm (7/8 inch) rod.
- F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.57 m (15 feet).
- G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:
1. Solid or split unplated cast iron.
  2. All plates shall be provided with set screws.
  3. Height adjustable clevis type pipe hangers.
  4. Adjustable floor rests and base flanges shall be steel.
  5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
  7. Riser clamps shall be malleable iron or steel.
  8. Rollers shall be cast iron.
  9. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.
- H. Miscellaneous materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of

hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.

I. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

J. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

K. Piping shall conform to the following:

1. Waste and Vent Drain to main stacks:

Pipe Size	Minimum Pitch
80 mm or DN 80 (3 inches) and smaller	2%
100 mm or DN 100 (4 inches) and larger	1%

2. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

### 3.4 TESTS

- A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.
- B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.
  1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections,

- tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
2. For an air test, an air pressure of 35 kPa (5 psig) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the air test.
  3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
  3. Final Tests: Either one of the following tests may be used.
    - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
    - b. Peppermint Test: Introduce (2 ounces) of peppermint into each line or stack.

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**SECTION 22 40 00  
PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.

**1.2 RELATED WORK**

- A. Sealing between fixtures and other finish surfaces: Section 07 92 00, JOINT SEALANTS.
- B. Flush panel access doors: Section 08 31 13, ACCESS DOORS AND FRAMES.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit plumbing fixture information in an assembled brochure, showing cuts and full detailed description of each fixture.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):  
The American Society of Mechanical Engineers (ASME):  
A112.6.1M-02(R2008).....Floor Affixed Supports for Off-the-Floor  
Plumbing Fixtures for Public Use  
A112.19.1M-04.....Enameled Cast Iron Plumbing fixtures  
A112.19.2M-03(R2008)....Vitreous China Plumbing Fixtures  
A112.19.3-2001(R2008)...Stainless Steel Plumbing fixtures (Designed for  
Residential Use)
- C. American Society for Testing and Materials (ASTM):  
A276-2003.....Stainless and Heat-Resisting Steel Bars and  
Shapes
- D. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM  
AMP 500-505  
Metal Finishes Manual (1988)
- E. American Society of Sanitary Engineers (ASSE):  
1016-05.....Performance Requirements for Individual  
Thermostatic, Pressure Balancing and Combination

Pressure Balancing and Thermostatic Control  
Valves for Individual Fixture Fittings

F. National Sanitation Foundation (NSF)/American National Standards  
Institute (ANSI):

61-03.....Drinking Water System Components-Health Effects

G. American with Disabilities Act(A.D.A) Section 4-19.4 Exposed Pipes and  
Surfaces

**PART 2 - PRODUCTS**

**2.1 STAINLESS STEEL**

A. Corrosion-resistant Steel (CRS):

1. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
2. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.

B. Die-cast zinc alloy products are prohibited.

**2.2 STOPS**

- A. Provide lock-shield loose key angle stops, straight stops or stops integral with faucet, with each compression type faucet whether specifically called for or not, including sinks in wood and metal casework, laboratory furniture and pharmacy furniture. Locate stops centrally above or below fixture in accessible location.
- B. Furnish keys for lock shield stops to COR.
- C. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
- D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple.

**2.3 ESCUTCHEONS**

Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

**2.4 LAMINAR FLOW CONTROL DEVICE**

- A. Smooth, bright stainless steel or satin finish, chrome plated metal laminar flow device shall provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device shall also have a flow control restrictor and have vandal resistant housing.
- B. Flow Control Restrictor:



1. Capable of restricting flow from 95 to 110 mL/s (1.5 to 1.7 gpm) for lavatories; 125 to 140 mL/s (2.0 to 2.2 gpm) for sinks P-505 through P-520, P-524 and P-528; and 170 to 190 mL/s (2.75 to 3.0 gpm) for dietary food preparation and rinse sinks.
2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 170 and 550 kPa (25 and 80 psi).
3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-clearing action, and is capable of easy manual cleaning.

C. Device manufactured by OMNI Products, Inc. or equal.

## **2.5 CARRIERS**

- A. ASME/ANSI A112.6.1M, lavatory, chair carrier for thin wall construction steel plate as detailed on drawing. All lavatory chair carriers shall be capable of supporting the lavatory with a 250-pound vertical load applied at the front of the fixture.

## **2.6 SINKS**

- A. (P-519) Sink (Surgeons Scrub-up, Knee Switch Control) Double units approximately 1600 by 560 mm (63 by 22 inches) and 305 mm (12 inches) deep.
1. Construction: Provide a minimum of 16 gage, Type 302/304 stainless steel, with exposed welds grounded and polished to blend with adjacent surfaces. Sound deadened front and back, front access panel, splash-retarding angle design. Exterior surfaces shall have a uniformed NAAMM Number 4 finish. Mount sink with wall hanger and stainless steel support brackets and ASME/ANSI A112.6.1M, Type III, heavy duty chair carriers and secure fixture with minimum 3/8-inch bracket studs and nuts. Cove corners with 6 mm (1/4-inch) radius. Set sink rim 914 mm (36 inches) above finished floor as shown.
2. Equip each scrub bay with knee paddle switch to control water flow automatically, via solenoid valve and thermostatic valve. Applying pressure to the knee panel shall activate the water flow. Flow shall stop when the user releases this switch.
3. Valve: Type T/P combination thermostatic and pressure balancing with chrome plated metal lever type operating handle and chrome plated metal or CRS face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be IPS. Provide external screwdriver check stops, and temperature limit stops. Set stops for a

maximum temperature of 43 degrees C (110 degrees F). All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of 380 mL/s at 310 kPa (6 gpm at 45 psi) pressure drop.

4. Gooseneck Spout: For each scrub bay, provide gooseneck spout with laminar flow device. Spout and trim shall be cast or wrought copper alloy and be chrome plated with smooth bright finish.
5. Grid Drain: Stainless steel stamped drain fitting, 114 mm (4-1/2 inch) top with 80 mm (3-inch) grid and 40 mm (1-1/2 inch) tailpiece.
6. Trap: Cast copper alloy, 40 mm (1-1/2 inch) P-trap, adjustable with connected elbow and nipple to the wall. Exposed metal trap surfaces and connection hardware shall be chrome plated with smooth bright finish.
7. Shelf: Surface mounted of Type 304 stainless steel with exposed surface in satin finish and stainless steel support brackets. Shelf shall be 203 mm (8-inches) wide and length as shown on the drawings.
8. Unit shall be Mac Medical or Continental Metal Products model 1-32E series or equal.

## **2.7 EMERGENCY FIXTURES**

- A. (P-708) Emergency Eye and Face Wash (Wall Mounted Drench Hose Type): Aerated, yellow plastic spray outlet, with dust cap and automatic flow control. Mount eye and face wash spray heads wall mounted to holder, verify dimension above finished floor. Receptor shall be indirect into adjacent sink fixture. Include emergency mixing valve within fully recessed stainless steel cabinet, and anti-siphon backflow prevention device mounted high on wall. Refer to drawings for configuration detail.

## **PART 3 - EXECUTION**

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed as specified under Section 07 92 00, JOINT SEALANTS.
- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.
- C. Through Bolts: For free standing marble and metal stud partitions refer to Section 10 21 13, TOILET COMPARTMENTS.
- D. Toggle Bolts: For hollow masonry units, finished or unfinished.
- E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4-inch) diameter bolts, and to extend at least 75 mm (3-inches) into masonry and be fitted with loose tubing or sleeves extending into

masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.

- F. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4-inch) threaded studs, and shall extend at least 35 mm (1-1/4 inches) into wall.
- G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
- H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.
- I. Do not use aerators on lavatories and sinks.

### **3.2 CLEANING**

At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

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**SECTION 22 62 00**  
**VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Central Laboratory and Healthcare Vacuum Systems: This section describes the labor, equipment, and services necessary for and incidental to the installation of piped medical vacuum systems and medical vacuum and waste anesthesia gas disposal systems (WAGD). Medical vacuum and WAGD systems shall be installed started, tested, and ready for use. The scope of work shall include all necessary piping, fittings, valves, cabinets, station outlets and inlets, rough ins, ceiling services, gages, alarms including low voltage wiring, vacuum pumps, electric motors and starters, receivers, and all necessary parts, accessories, connections and equipment. Match existing station inlet terminal connections.
- B. The contractor shall provide all elements and accessories required for a complete system according to the most recent edition of NFPA 99C, Gas and Vacuum Systems.
- C. All necessary connections to owner furnished equipment shall be made as indicated on the documents. A separate construction isolation valve shall be made at the point of connection to an existing vacuum system.
- D. Electrical power and control wiring for vacuum pump(s), WAGD Producer(s), ceiling columns, alarms wiring from equipment to alarm panels, and modular accessories associated with the system(s) shall be included.
- E. Pressure testing, cross connection testing and final testing per NFPA 99 most recent edition and using procedures shall be performed.
- F. The contractor shall retain a qualified third party medical vacuum verifier acceptable to the engineer and VA to perform and attest to final verification of the systems. The contractor shall make all corrections as determined by this third party verifier, including additional testing if necessary to attain full and unqualified certification.

- G. Coordinate with owner retained verifier for final verification of the systems. Make corrections as required, including additional testing if necessary to attain full and unqualified certification.

#### **1.2 RELATED WORK**

- A. Section 07 84 00, FIRESTOPPING: Sealing around pipe penetrations to maintain the integrity of time rated construction.
- B. Section 07 92 00, JOINT SEALANTS: Sealing around pipe penetrations through the floor to prevent moisture migration.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General requirements and items common to more than one section of Division 22.
- D. Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES: Laboratory and Healthcare Gases and Vacuum Alarms.
- E. SECTION 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES: Laboratory and Healthcare Gas Piping and Equipment:

#### **1.3 QUALITY ASSURANCE**

- A. Installation and Start-up: The manufacturer will provide factory authorized representatives to review installation and perform initial start up of system.
- B. Contractor shall include with submittals an affidavit attesting to compliance with all relevant paragraphs of NFPA 99 most recent edition. Personnel assembling medical vacuum and WAGD system shall meet NFPA 99 5.1.10.10.11 "Qualification of Installers" and hold medical gas endorsements as under ASSE 6010. The Contractor shall furnish documentation attesting that all installed piping materials were purchased cleaned and complied with the requirements of NFPA 99 5.1.10.1 and 5.1.10.2. Electrical Control systems and Medical vacuum Alarms are to be UL listed as assemblies with label affixed. Medical vacuum and WAGD controls are to be wired in accordance with NEC.
- C. Equipment Installer: The equipment installer shall show documentation proving that the personnel installing the equipment meet the standards set by the American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas System Installers. Show technical qualifications and previous experience in installing medical gas equipment on three similar projects. Submit names and addresses of referenced projects. The equipment install shall perform the following coordination functions:

1. Coordinate with other trades to ensure timely installations and avoid conflicts and interferences.
  2. Work with the metal stud partition installer and/or mason to ensure anchors, sleeves and similar items are provided in sufficient time to avoid delays; chases and openings are properly sized and prepared.
  3. Coordinate with VA to ensure medical vacuum inlets, whether owner supplied or contractor supplied, in walls, ceiling and all equipment is provided by the same Medical Vacuum Equipment Manufacturer satisfactory to the owner.
  4. The contractor shall coordinate with the Medical Vacuum System Verifier to deliver a complete, tested medical gas installation ready for owner's use.
- D. Equipment Supplier: The Equipment supplier shall demonstrate evidence of installing equivalent product at three installations similar to this project that has been in satisfactory and efficient operation for three years. Names and addresses where the product is installed shall be submitted for verification.
- E. Medical Gas System Testing Organization: The Medical vacuum verifier shall show documentation proving that the medical gas verifier meet the standards set by the American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas System Verifiers. The testing shall be conducted by a party technically competent and experienced in the field of medical gas pipeline testing. Such testing shall be performed by a party other than the installing contractor.
- F. Names of three projects where testing of vacuum systems has been performed by the testing agency shall be provided. The name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification shall be included in the documentation.
- G. The testing agency's detailed procedure which will be followed in the testing of this project shall be submitted. In the testing agency's procedure documentation, include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm

tests, purity tests, etc., as required by this specification. For purity test procedures, data on test methods, types of equipment to be used, calibration sources and method references shall be submitted.

- H. Installation and Start-up: The manufacturer shall provide factory authorized representatives to review the installation and perform the initial startup of the system. The factory authorized representatives shall submit a report to the construction administrator and to the Contractor. The Contractor shall make all corrections identified by the factory authorized representative.
- I. Certification: The Final inspection documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.
- J. The installing contractor shall maintain as-built drawings of each completed phases for verification; and, shall provide the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings shall be provided, and a copy of them on Auto-Cad version (R-14 or later) provided on compact disk.

#### **1.4 SUBMITTALS**

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Complete specifications for the product intended to be installed, dimensional drawings, and wiring schematics.
  - 2. Package drawing indicating package style, dimensions when complete, method of disassembly and sizes of subsections for rigging and installation.
  - 3. Piping.
  - 4. Valves.
  - 5. Inlet and outlet cocks
  - 6. Valve cabinets.
  - 7. Gages.
  - 8. Station inlets, and rough in assemblies.
  - 9. Ceiling services.

10. Alarm controls and panels.
  11. Vacuum switches.
  12. Vacuum bottle brackets.
- C. Station Inlets: A letter from manufacturer shall be submitted stating that inlets are designed and manufactured to comply with NFPA 99. Inlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer, certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.
- D. Certification: The completed systems have been installed, tested, purged and analyzed in accordance with the requirements of this specification.
- E. A notarized affidavit from the verifier stating that the verifier undertakes to verify this project and thus agrees to disqualify themselves from supplying any equipment which will be included in the scope of their verification. No verifier who supplies equipment shall be permitted to verify that equipment. Statement declaring that the vacuum system manufacturer has no fiduciary interest in the verifier and that the verifier is not an agent or representative of the vacuum system manufacturer. Statement declaring that the contractor has no fiduciary interest in the third party verifier and that the third party verifier has no fiduciary interest in the contractor.

#### **1.5 TRAINING**

- A. The services of a competent instructor shall be provided for not less than two four-hour periods for instructing personnel in the operation and maintenance of the vacuum systems, on the dates requested by COR.
- B. The other training requirements specified in Section 01 00 00, GENERAL REQUIREMENTS shall be coordinated with the above paragraph

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the test by the basic designation only.
- B. American National Standards Institute (ANSI):



- A13.1-2007.....Scheme for Identification of Piping Systems  
B16.22-01 (R2005).....Wrought Copper and Bronze Solder-Joint Pressure  
Fittings  
B40.1-(2006)..... Pressure Gauges and Gauge Attachments  
C. American Society for Testing and Materials (ASTM):  
B819-00.....Standard Specification for Seamless Copper Tube  
for Medical Gas Systems  
D. American Society of Mechanical Engineers (ASME):  
Section IX-04.....Welding and Brazing Qualifications  
E. American Welding Society (AWS):  
AWS A5.8/A5.8M-2004.....Brazing Filler Metal  
AWS B2.2-91.....Standard for Brazing Procedure and Performance  
Qualification (Modified per NFPA 99)  
F. Compressed Gas Association (CGA):  
P-9-92.....Inert Gases Argon, Nitrogen and Helium  
G. National Electrical Manufacturers Association (NEMA):  
ICS-6-(1993, R 2006)....Industrial Controls and Systems Enclosures  
H. National Fire Protection Association (NFPA):  
70(2007).....National Electric Code  
99-2005.....Health Care Facilities with 2005 errata  
I. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)  
J. Manufacturing Standardization Society (MSS):  
MSS-SP-72-99.....Ball Valves With Flanged or Butt Welding For  
General Purpose  
MSS-SP-110-96.....Ball Valve Threaded, Socket Welding, Solder  
Joint, Grooved and Flared Ends  
MSS-SP-73-03.....Brazing Joints for Copper and Copper Alloy  
Solder Pressure Fittings

#### **1.7. MAINTENANCE SUPPORT**

- A. The medical vacuum equipment manufacturer shall demonstrate a national factory direct service capability able to perform major overhauls. The medical vacuum equipment manufacturer shall offer factory direct preventative maintenance contract for the owner's consideration. The medical vacuum equipment manufacturer shall offer formal maintenance training courses.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL PRODUCT REQUIREMENTS**

- A. One Medical Vacuum Equipment Manufacturer shall supply the medical vacuum system(s) and equipment to include outlets, valves and gauges, valve boxes, alarm panels, manifolds, medical air, instrument air, vacuum and WAGD sources.

### **2.2 PIPING**

- A. Copper Tubing: Copper tubing shall be type "K" or "L", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ANSI B16.22 or brazing fittings complying with MSS SP-73. The copper tubing size designated reflects nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".
- B. Brazing Alloy: The brazing alloy shall comply with AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux shall be strictly prohibited for copper to copper connections.
- C. Piping identification labels shall be applied at time of installation in accordance with current NFPA. Supplementary color identification shall be in accordance with CGA Pamphlet C-9.
- D. Special Fittings: The following special fittings shall be permitted to be used in lieu of brazed joints:
  - 1. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint.

### **2.3 EXPOSED LABORATORY AND HEALTHCARE VACUUM PIPING**

- A. Finished Room: Use full iron pipe size chrome plated brass piping shall be used for exposed laboratory and healthcare vacuum piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
  - 1. Pipe: Fed. Spec. WW-P-351, standard weight.
  - 2. Fittings: Fittings shall comply with ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
  - 3. Nipples: Nipples shall comply with ASTM B 687, Chromium-plated.

4. Unions: Unions shall comply with Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
5. Valves: Valves shall comply with Mss SP-72, SP-110, Brass or bronze with chrome finish.

#### 2.4 VALVES

- A. Ball: Ball valves shall be in line, other than zone valves in cabinets.
  1. Sixty five millimeter or DN65 (2 1/2 inches) and smaller: Ball valves shall be bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full ported, three piece or double union end connections, teflon seat seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle.
  2. Eighty millimeter or DN80 to 100 millimeter or DN100 (3" to 4" inches): Ball valves shall be bronze/ brass body, Fed. Spec. MSS SP72 & SP 110, Type II, Class 150, Style 1 with tubing extensions brazed to flanges, full ported, three piece, double seal, teflon seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle.
- B. Check:
  1. Check valves eighty millimeters (DN80) (3 inches) and smaller: brass and Bronze body, straight through design for minimum pressure drop, spring loaded, self aligning with teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, 2750 kPa (400 psi) WOG minimum working pressure.
  2. One hundred millimeter or DN100 (4 inches) and larger check valves shall be iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 1025 kPa (150 psi) WSP.
- C. Zone valve in cabinet shall be ball valve with bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non shock gas working pressure or vacuum service to 29 inch Hg, blowout proof stem, one quarter turn of handle to completely open or close. Tubing extensions, factory brazed, pressure tested, cleaned for oxygen service shall be provided. A 3 mm (1/8 inch) NPT gauge port shall be

provided for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick on labels. Valves shall be in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
MEDICAL VACUUM	Black letters on white background	WHITE
Evacuation (Waste Gas)	White letters on purple background	PURPLE

## 2.5 VALVE CABINETS

- A. Valve cabinets shall be flush mounted, commercially available item for use with medical gas services, constructed from steel not lighter than 1.3 mm (18 gage) steel or extruded aluminum not lighter than 1.9 mm (14 gage). The valve cabinets shall be rigidly assembled, of adequate size to accommodate all valve(s) and fittings indicated. Holes shall be predrilled to receive pipe connections. These pipe connections shall be made outside of the valve box. Anchors shall be provided to secure cabinet to wall construction. Openings in cabinet shall be sealed to be dust tight. Bottom of cabinet shall be located 1375 mm (4 foot 6 inches) above finished floor.
- B. Engraved rigid plastic identification plate shall be mounted on the wall above or adjacent to the cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate shall be clearly visible at all times. Inscriptions shall be provided on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS." The final wording must be approved by the VA project manager.
- C. Cover plate: The cover plate shall be fabricated from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. A cover window shall be provided of

replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. The following shall be permanently painted or stenciled on window: "FOR EMERGENCY SHUT-OFF VALVES ONLY, SHUT OFF VALVES FOR PIPED GASES", or equivalent wording. The valve cabinet shall be configured such that it is not possible to install window with any valve in the closed position. Each valve shall have a pressure gauge upstream of valve and this pressure gauge shall be inside valve box.

- D. Cabinets and isolation valves shall be located and piped as shown, and at a minimum, so as to allow the isolation of each smoke compartment separately. Each cabinet shall serve no more than one smoke compartment.

## **2.6 GAGES**

### **A. Vacuum Gages:**

1. For vacuum line adjacent to source equipment the vacuum gages shall comply with ANSI B40.1, vacuum gage type, size 115 mm (4-1/2 inches), gage listed for vacuum, accurate to within 2-1/2 percent, with metal case. The vacuum gage range shall be 0 to -100 kPa (0-30 inches Hg). Dial graduations and figures shall be black on a white background, or white on a black background. Label shall be for vacuum service. A gage cock shall be installed. Compound gages shall be installed for Vacuum system.
2. For vacuum service upstream of main shutoff valve: A 40 mm (1-1/2 inch) diameter gage shall be provided with steel case, bourdon tube and brass movement, dial range 0 to -100 kPa (0-30 inches Hg). Compound gages shall be provided for Vacuum system.

## **2.7 STATION INLETS**

### **A. Vacuum Station inlets:**

1. Station inlets shall be brass, stainless steel or chromed metal non-interchangeable quick connections, BeaconMedaes Diamond II, Pin Index.
2. The outlet station shall be made, cleaned, and packaged to NFPA 99 standards and shall be UL listed and CSA certified.

3. A coupler shall be provided that is non-interchangeable with other services, and leak proof under three times normal working pressure. Threaded DISS connector shall be per CGA standards
4. Each station inlet shall be equipped with an automatic valve to conform with NFPA 99. Valves shall be placed in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing.
5. Each inlet shall be securely fastened to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) 10 mm outside diameter (3/8-inch outside diameter) tubing for connection to supply tubing. Stub tubing shall be labeled for appropriate service. Rough in shall be indexed and gas specified latch valve with non-interchangeable safety keying with color coded gas service identification.
6. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPUs) shall be furnished under this specification but installed by manufacturer of PBPUs before initial test specified herein.
7. Completion kits (valve body and face plate) shall be installed for the remainder of required tests.

## **2.8 STATION INLET ROUGH-IN**

- A. Station inlet rough in shall be Flush mounted, and protected against corrosion. Rough in shall be anchored securely to unit or wall construction.
- B. The modular cover plate shall be constructed from die cast plate, two piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, secured to rough in with stainless steel or chromium plated countersunk screws. The latch mechanism shall be designed for one handed, single thrust mounting and one handed fingertip release of secondary equipment.
- C. Cover Plate for Prefabricated Bedside Patient Units (PBPUs) shall be One piece with construction and material as indicated for modular cover plate.
- D. Permanent, metal or plastic, identification plates shall be provided securely fastened at each inlet opening, with inscription for appropriate service using color coded letters and background. Metal

plates shall have letters embossed on baked on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
MEDICAL VACUUM	Black letters on white background
EVACUATION (Waste Gas)	White letters on purple background

## **2.9 VACUUM SWITCHES**

- A. Vacuum switches shall be general purpose, contact or mercury type, allowing both high and low set points, with contact type provided with a protective dust cover. The vacuum switch shall have an adjustable range set by inside or outside adjustment. Vacuum switches shall activate when indicated by alarm requirements. One orifice nipple (or DISS demand check valve) shall be used for each sensor switch.

## **2.10 VACUUM BOTTLE BRACKET**

- A. Vacuum bottle bracket shall be single plate of one piece, .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal or aluminum, finish matching cover of adjoining vacuum inlet. All components shall be of same material as plate and assembly anchored securely. The bracket shall be provided and plastic vacuum bottle holder for each vacuum wall inlet.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. All installation shall be performed in strict accordance with NFPA 99 5.1.10. Brazing procedures shall be as detailed in NFPA 99 5.1.10.5. Brazing shall be performed only by brazers qualified under NFPA 99 5.1.10.10.11. Where piping runs underground, the installation shall be made in accordance with NFPA 99 5.1.10.10.5.
- B. Cast escutcheon shall be installed with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- C. Open ends of tube shall be capped or plugged at all times or otherwise sealed until final assembly.
- D. Piping shall be cut square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. the

tubing shall be reamed to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. The tubing shall be worked into place without springing or forcing. The tubing shall be bottomed in socket so there are no gaps between tube and fitting. Care shall be exercised in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease from being introduced into the tubing. Where contamination has occurred, material shall be no longer suitable for vacuum service and new, sealed tube sections used..

- E. Piping shall be supported with pipe trays or hangers at intervals as shown on the drawings or as defined in NFPA 99 Table 5.1.10.10.4.5. Piping shall not be supported by other piping. Isolation of copper piping from dissimilar metals shall be of a firm, positive nature. Duct tape is not acceptable as an isolation material.
- F. Valves and other equipment shall be rigidly supported to prevent strain on tube or joints.
- G. Piping exposed to physical damage shall be protected.
- H. During any brazing operation, the interior of the pipe shall be purged continuously with oil free, dry nitrogen NF, following the procedure in NFPA 99 5.1.10.5.5. At the completion of any section, all open pipe ends shall be capped using an EXTERNAL cap. The flow of purged gas shall be maintained until joint is cool to touch. The use of flux is prohibited when making of joints between copper to copper pipes and fittings.
- I. Tubing shall not be bent. Fittings shall be used in all change of direction or angle.
- J. After installation of the piping, but before installation of the outlet valves, blow lines clear using nitrogen NF.
- L. Pressure and vacuum switches, transmitter and gauges shall be installed to be easily accessed, and provide access panel where installed above plaster ceiling. Pressure switch and sensors shall be installed with orifice nipple between the pipe line and switches/sensors.
- K. Pipe labeling shall be applied during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.



L. After initial leakage testing is completed, the piping shall be allowed to remain pressurized with testing gas until testing agency performs final tests.

M. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked partitions, or floors, fire stopping shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, Clearances between raceways and openings with the fire stopping material shall be completely filled and sealed..

2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

N. A vacuum gage 40mm (1 1/2 inch) diameter line shall be installed downstream of each zone valve in cabinets.

O. Zone valves shall be provided in cabinets where indicated and outside each Operating Room and a minimum one zone valve assembly for each 18 outlets.

P. Piping shall be labeled with name of service, identification color and direction of flow. Where non-standard pressures are piped, pressure shall be labeled. Labels shall be placed at least once every 20 feet of linear run or once in each story (whichever is more frequent). A label shall additionally be placed immediately on each side of all wall or floor penetrations. Pipe labels shall be self adhesive vinyl type or other water resistant material with permanent adhesive colored in accordance with NFPA 99 Table 5.1.11 and shall be visible on all sides of the pipe. Each master alarm signal shall be labeled for function after ring out. Each zone valve shall be labeled and each area alarm labeled for the area of control or surveillance after test. Labels shall be permanent and of a type approved by the VAMC

Q. Alarms and valves shall be labeled for service and areas monitored or controlled. Coordinate with the VAMC for final room or area designations. Valves shall be labeled with name and identification color of the gas and direction of flow

### **3.2 INSTALLER TESTING**

- A. Prior to declaring the lines ready for final verification, the installing contractor shall strictly follow the procedures for verification as described in NFPA 99 5.1.12.2 and attest in writing over the notarized signature of an officer of the installing company the following;
1. That all brazing was conducted by brazers qualified to ASSE 6010 and holding current medical gas endorsements.
  2. That all brazing was conducted with nitrogen purging. (Procedure per NFPA 99 5.1.10.5.5).
  3. That the lines have been blown clear of any construction debris using oil free dry nitrogen or air are clean and ready for use. (Procedure per NFPA 99 5.1.12.2.2).
  4. That the assembled piping, prior to the installation of any devices, maintained a test pressure 1 1/2 times the standard pressures listed in NFPA 99 Table 5.1.11 without leaks. (Procedure per NFPA 99 5.1.12.2.3).
  5. That after installation of all devices, the pipeline was proven leak free for 24hours at a pressure 20% above the standard pressures listed in NFPA 99 Table 5.1.11. (Procedure per NFPA 99 5.1.12.2.2.6)
  6. That the systems have been checked for cross connections and none were found. (Procedure per NFPA 99 5.1.12.2.4)
  7. That the manufacturer has started up all medical air compressors, medical vacuum pumps WAGD producers, liquid oxygen system(s) and manifolds, and that they are in operating order.
- B. Four originals of the affidavit, shall be distributed; (1) to the engineer, (1) to the owners representative, (1) to the general contractor and (1) to the verifier.

### **3.3 VERIFIER TESTING**

- A. Prior to handing over the systems to VAMC, the contractor shall retain a Verifier acceptable to the engineer and owner who shall follow strictly the procedures for verification as described in NFPA 99 5.1.12.3 and provide a written report and certificate bearing the notarized signature of an officer of the verification company which contains at least the following:

1. A current ACORD insurance certificate indicating professional liability coverage in the minimum amount of \$1 Million per occurrence, and general aggregate liability in the minimum amount of \$1 Million, valid and in force when the project is to be verified. General liability insurance is not alone acceptable.
2. An affidavit bearing the notarized signature of an officer of the verification company stating that the verification company is not the supplier of any equipment used on this project or tested in this report and that the verification contractor has no relationship to, or pecuniary interest in, the manufacturer, seller, or installer of any equipment used on this project or tested in this report
3. A listing of all tests performed, listing each source, outlet, valve and alarm included in the testing.
4. An assertion that all tests were performed by a Medical Vacuum System Certified Medical Gas or vacuum Verifier or by individuals qualified to perform the work and holding valid qualifications to ASSE 6030 and under the immediate supervision a Verifier. Include the names, credential numbers and expiration dates for all individuals working on the project.
5. A statement that equipment used was calibrated at least within the last six months by a method traceable to a National Bureau of Standard Reference and enclosing certificates or other evidence of such calibration(s). Where outside laboratories are used in lieu of on site equipment, those laboratories shall be named and their original reports enclosed.
6. A statement that where and when needed, equipment was re calibrated during the verification process and describing the method(s) used.
7. A statement that the systems were tested and found to be free of debris to a procedure per NFPA 99 5.1.12.3.7.
8. The flow from each outlet when tested to a procedure per NFPA 99- 5.1.12.3.10.
9. A statement that the systems were tested and found to have no cross-connections to a procedure per NFPA 99 5.1.12.3.3.
10. A statement that the systems were tested and found to be free of contaminants to a procedure per NFPA 99 5.1.12.3.8 except that the

- purity standard shall be 2 ppm difference for halogenated hydrocarbons and 1 ppm total hydrocarbons (as methane).
11. Statement that all local signals function as required under NFPA 99 5.1.3.4.7 and as per the relevant NFPA 99 sections relating to the sources.
  12. A listing of local alarms, their function and activation per NFPA 99 5.1.12.3.14.
  13. A listing of master alarms, their function and activation, including pressures for high and low alarms per NFPA 99 5.1.12.3.5.2.
  14. A listing of area alarms, their function and activation pressures per NFPA 99 5.1.12.3.5.3.
  15. A statement that the sources include all alarms required by NFPA 99 Table A.5.1.9.5.
  16. The concentration of each component of NFPA 99 Table 5.1.12.3.12 in the medical air after 24hours of operation of the medical air source.
  17. The concentration of each gas at each outlet as specified in NFPA 99 5.1.12.3.11.
  18. A statement that all valves and alarms are accurately labeled as to zone of control.
  19. Provide four originals of this affidavit, and report, distributed; (1) to the engineer, (1) to the owner's representative, (1) to the general contractor and (1) to the installing contractor.
- B. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.
- C. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.
- D. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the

outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.

E. Inlet flow test:

1. Test all inlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
2. Needle valve vacuum inlets must draw no less than 1.0 scfm with adjacent inlet flowing, at a dynamic inlet pressure of 12-inches Hg, and a static vacuum of 15-inches Hg.
3. Vacuum inlets must draw no less than 85 Lpm (3.0 scfm) with adjacent inlet flowing, at a dynamic inlet pressure of 40 kPa (12-inches Hg), and a static vacuum of 50 kPa (15-inches Hg).
4. Anesthesia evacuation inlets must draw no less than 1 L/mm (1.0 scfm) at a dynamic inlet pressure of 40 kPa (12-inches Hg), and a static vacuum of 50 kPa (15-inches Hg).

- - - E N D - - -

**SECTION 22 63 00**  
**GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Central Laboratory and Healthcare Gas Systems: Consisting of oxygen, nitrous oxide, nitrogen, and compressed air services; complete, ready for operation, including all necessary piping, fittings, valves, cabinets, station outlets, rough-ins, ceiling services, gages, alarms including low voltage wiring, nitrogen control panels, cylinder manifolds, air compressors, electric motors and starters, air dryers, filters, pressure regulators, dew point, carbon monoxide monitors and all necessary parts, accessories, connections and equipment. Match existing station outlet and inlet terminal connections.
- C. Nitrous Oxide and Nitrogen Systems: Ready for connection to cylinders, but not including cylinders.
- D. Supply Lines Outside of Building (including PVC protective pipe): As specified in this Section.
- E. Laboratory and healthcare gas system alarm wiring from equipment to alarm panels.

**1.2 RELATED WORK**

- A. Sealing around pipe penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. Sealing around pipe penetrations through the floor to prevent moisture migration: Section 07 92 00, JOINT SEALANTS.
- C. General requirements and items common to more than one section of Division 22. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Vacuum Piping and Equipment: SECTION 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

**1.3 QUALITY ASSURANCE**

- A. Materials and Installation: In accordance with NFPA 99, and as specified.
- B. Equipment Installer: Show technical qualifications and previous experience in installing laboratory and healthcare equipment on three similar projects. Submit names and addresses of referenced projects.
- C. Equipment Supplier: Show evidence of equivalent product installed at three installations similar to this project that has been in satisfactory and efficient operation for three years. Submit names and addresses where the product is installed.
- D. Laboratory and healthcare System Testing Organization: The testing shall

be conducted by a party technically competent and experienced in the field of laboratory and healthcare pipeline testing. Such testing shall be performed by a party other than the installing contractor.

- E. Provide names of three projects where testing of medical or laboratory gases systems has been performed by the testing agency. Include the name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification.
- F. Submit the testing agency's detailed procedure which will be followed in the testing of this project. Include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.
- G. Certification: Provide documentation prior to submitting request for final inspection to include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.
- H. Installing contractor shall maintain as-built drawings of each completed phases for verification; and, shall provide the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings are to be provided, and a copy of them on Auto-Cad version (R-14 or later) provided on compact disk. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

#### **1.4 SUBMITTALS**

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Piping.
  - 2. Valves.
  - 3. Inlet and outlet cocks
  - 4. Valve cabinets.
  - 5. Gages.
  - 6. Station outlets and rough-in assemblies.
  - 7. Ceiling services.
  - 8. Alarm controls and panels.

- 9. Pressure Switches.
- 10. Nitrogen control panels.
- C. Station Outlets: Submit letter from manufacturer stating that outlets are designed and manufactured to comply with NFPA 99. Outlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer, certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.
- D. Certification: The completed systems have been installed, tested, purged and analyzed in accordance with the requirements of this specification.

#### **1.5 TRAINING**

- A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the laboratory and healthcare gas systems, on the dates requested by COTR.
- B. Coordinate with other requirements specified in Section 01 00 00, GENERAL REQUIREMENTS.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the test by the basic designation only.
- B. American Society for Testing and Materials (ASTM):  
B819-(R2006).....Seamless Copper Tube for Medical Gas Systems
- C. American Society of Mechanical Engineers (ASME):  
A13.1-07.....Scheme for Identification of Piping Systems  
B16.22-01(R2005).....Wrought Copper and Bronze Solder-Joint Pressure Fittings  
B40.100-98.....Pressure Gauges and Gauge Attachments  
Boiler and Pressure Vessel Code -  
Section VIII-07.....Pressure Vessels, Division I  
Section IX-07.....Welding and Brazing Qualifications
- D. American Welding Society (AWS):  
AWS A5.8-04.....Brazing Filler Metal  
AWS B2.2-91.....Standard for Brazing Procedure and Performance Qualification (Modified per NFPA 99)
- E. Compressed Gas Association (CGA):  
C-9-04.....Standard Color Marking of Compressed Gas Cylinders



G-4.1-04.....Cleaning Equipment for Oxygen Service  
G-10.1-04.....Nitrogen, Commodity  
P-9-01.....Inert Gases Argon, Nitrogen and Helium  
V-1-05.....Standard for Compressed Gas Cylinder Valve  
Outlet and Inlet Connections

- F. National Electrical Manufacturers Association (NEMA):  
ICS-6-93(R2006).....Industrial Controls and Systems Enclosures
- G. National Fire Protection Association (NFPA):  
99-05.....Health Care Facilities
- H. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)
- I. Manufacturing Standardization Society (MSS):  
MSS-SP-72-99.....Ball Valves With Flanged or Butt Welding For  
General Purpose  
MSS-SP-110-96.....Ball Valve Threaded, Socket Welding, Solder  
Joint, Grooved and Flared Ends  
MSS-SP-73-03.....Brazing Joints for Copper and Copper Alloy  
Solder Pressure Fittings

## **PART 2 - PRODUCTS**

### **2.1 PIPING**

- A. Copper Tubing: Type "K" or "L", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ASME B16.22 or brazing fittings complying with MSS SP-73. Size designated reflecting nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".
- B. Brazing Alloy: AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux is strictly prohibited for copper-to-copper connections.
- C. Apply piping identification labels shall be done at time of installation in accordance with current NFPA. Supplementary color identification shall be in accordance with CGA Pamphlet C-9.

### **2.2 EXPOSED LABORATORY AND HEALTHCARE GASES PIPING**

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed laboratory and healthcare gas piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
  - 1. Pipe: Fed. Spec. WW-P-351, standard weight.
  - 2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).

3. Nipples: ASTM B 687, Chromium-plated.
4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
5. Valves: Mss SP-72, SP-110, Brass or bronze with chrome finish.

## 2.3 VALVES

### A. Ball: In-line, other than zone valves in cabinets:

1. Seventy five millimeter (2 1/2 inches) and smaller: Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full ported, three-piece or double union end connections, teflon seat seals, full flow, 4125 kPa ( 600 psi) WOG minimum working pressure, with locking type handle and cleaned for oxygen service. An acceptable manufacturer that meets the specification: Jomar model S-100.
2. Eighty to one hundred millimeter (3-4 inches): Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110, Type II, Class 150, Style 1 with tubing extensions brazed to flanges, full ported, three piece, double seal, teflon seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle, and cleaned for oxygen service.

### B. Check:

1. Eighty millimeter (3 inches) and smaller: brass and Bronze body, straight through design for minimum pressure drop, spring loaded, self aligning with teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, cleaned for oxygen use, 2750 kPa (400 psi) WOG minimum working pressure.
2. One hundred millimeter (4 inches) and larger: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 1025 kPa (150 psi) WSP.

### C. Zone Valve in Cabinet: Ball valve, bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non-shock gas working pressure service to 29 inch Hg, cleaned for oxygen service, blowout proof stem, one quarter turn of handle to completely open or close. Provide tubing extensions factory brazed, pressure tested, cleaned for oxygen service. Provide 3 mm (1/8 inch) NPT gauge port for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to

system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick-on labels. Install valves in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
OXYGEN	White letters on green background	GREEN
NITROUS OXIDE	White letters on blue background	BLUE
NITROGEN	White letters on black background	BLACK
MEDICAL AIR	Black or white letters on yellow background	YELLOW
CARBON DIOXIDE	Black or white letters on gray background	GRAY

#### 2.4 VALVE CABINETS

- A. Flush mounted commercially available item for use with laboratory and healthcare services, not lighter than 1.3 mm (18 gage) steel or 1.9 mm (14 gage) extruded aluminum, rigidly assembled, of adequate size to accommodate valve(s) and fittings. Punch or drill sides to receive tubing. Provide anchors to secure cabinet to wall construction. Seal openings in cabinet to be substantially dust tight. Locate bottom of cabinet approximately 1375 mm (4 foot 6 inches) above floor.
- B. Mount engraved rigid plastic identification plate on wall above or adjacent to cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate must be clearly visible at all times. Provide inscriptions on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS."
- C. Cover plate: Fabricate from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. Provide cover window of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. Permanently paint or stencil on window: "FOR EMERGENCY SHUT-OFF VALVES ONLY, SHUT-OFF VALVES FOR PIPED GASES", or equivalent wording. Configure such that it is not possible to install window with any valve in the closed position. Each valve shall have gauge upstream of valve inside valve box.
- D. Cabinets and isolation valves shall be located and piped as shown, and at a minimum, so as to allow the isolation of each smoke compartment

separately. No cabinet shall serve more than one smoke compartment.

## **2.5 GAGES**

- A. Pressure Gages: Includes gages temporarily supplied for testing purposes.
1. For line pressure use adjacent to source equipment: ASME B40.1, pressure gage, single, size 115 mm (4-1/2 inches), for compressed air, nitrogen and oxygen, accurate to within two percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gage shall be cleaned for oxygen use, labeled for appropriate service, and marked "USE NO OIL". Install with gage cock.
  2. For all services downstream of main shutoff valve: Manufactured expressly for oxygen use but labeled for appropriate service and marked "USE NO OIL", 40 mm (1-1/2 inch) diameter gage with dial range 1-690 kPa (1-100 psi) for medical gas services.

## **2.6 STATION OUTLETS**

For all services: Brass, stainless steel or chromed metal non-interchangeable quick connections for appropriate service, BeaconMedaes Diamond II, Pin Index. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation, for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet securely to outlet rough-in to prevent floating, and provide each outlet with a capped stub length of 6 mm (1/4-inch) (10 mm (3/8-inch) outside diameter) tubing for connection to supply. Label stub tubing for appropriate service. Adjustable to compensate for variations in plaster or cover thickness. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPUs) are furnished under this specification but installed by manufacturer of PBPUs before initial tests specified herein. Install outlet completion kits (valve body and face plate) for the remainder of required tests.

## **2.7 STATION OUTLET ROUGH-IN**

- A. Flush mounted, protected against corrosion. Anchor rough-in securely to unit or wall construction.
- B. Modular Cover Plate: Die cast plate, two-piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, secured to rough-in with stainless steel or chromium plated countersunk screws.

- C. Cover Plate for Prefabricated Bedside Patient Units (PBPU): One-piece with construction and material as indicated for modular cover plate.
- D. Provide permanent, metal or plastic, identification plates securely fastened at each outlet and inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked-on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
OXYGEN	White letters on green background
NITROUS OXIDE	White letters on blue background
NITROGEN	White letters on black background
MEDICAL AIR	Black or white letters on yellow
CARBON DIOXIDE	White letters on gray background

## 2.9 ALARMS

- A. Provide all low voltage control wiring, except for wiring from alarm relay interface control cabinet to ECC, required for complete, proper functioning system, in conformance with Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Run wiring in conduit, in conformance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- B. Area Alarm Functions:
  - 1. Oxygen, nitrous oxide, carbon dioxide and compressed air alarms:  
Pressure alarms: Functions when pressure in branch drops below 275 kPa (40 psi), plus/minus 14 kPa (two psi) or increases above 235 kPa (60 psi), plus/minus 14 kPa (two psi) set points; operated by pressure switches or transmitters.
  - 2. Nitrogen alarms: Pressure alarms: Functions when pressure in branch drops below 1310 kPa (190 psi), plus/minus 14 kPa (two psi) or increases above 1500 kPa (220 psi), plus/minus two psi) set points; operated by pressure switches or transmitters.
  - 3. Vacuum alarms: Low vacuum alarm: Functions when vacuum in branch drops below 40 kPa (12-inches) Hg; operated by vacuum switch.
- E. Alarm Panels:
  - 1. General: Modular design, easily serviced and maintained; alarms operate on alternative current low voltage control circuit; provide required number of transformers for efficient functioning of complete

- system. Alarm panels shall be integral units, reporting oxygen, compressed air, and vacuum services as required.
2. Box: Flush mounted, sectional or one piece, corrosion protected. Size to accommodate required number of service functions for each location, and for one audible signal in each box. Anchor box securely.
  3. Cover plate: Designed to accommodate required number of signals, visual and audible, for each location, and containing adequate operating instructions within the operator's view. Bezel shall be extruded aluminum, chromium plated metal, or plastic. Secure to the box with chromium plated or stainless steel countersunk screws.
  4. Service indicator lights: Red translucent plastic or LED with proper service identification inscribed thereon. Number of lights and service instruction shall be as required for each location. Provide each panel with a green test button of the same material, inscribed with "PUSH TO TEST" or similar message.
  5. Audible signal: Provide one in each alarm panel and connect electrically with all service indicator light functions.
  6. Controls:
    - a. Visual signal: When the condition occurs which any individual service indicator light is to report, button for particular service shall give a lighted visual signal which cannot be canceled until such condition is corrected.
    - b. Audible signal: Alarm shall give an audible signal upon circuit energization of any visual signal. Audible signal shall be continuous until silenced by pushing a button. This shall cancel and reset audible only, and not affect the visual signal. After silencing, subsequent alarms shall reactivate the audible alarm.
    - c. Signal tester: Test button or separate normal light shall be continuously lighted to indicate electrical circuit serving each individual alarm is energized. Pushing test button shall temporarily activate all visual signals and sound audible signal, thereby providing desired indications of status of system.

## **2.11 PRESSURE SWITCHES**

General purpose, contact or mercury type, allowing both high and low pressure set points, with contact type provided with a protective dust cover; adjustable range set by inside or outside adjustment; switches activate when indicated by alarm requirements. Use one orifice nipple (or DISS demand check valve) for each sensor or pressure switch.

## **2.12 NITROGEN CONTROL PANEL (NCP)**

- A. General: For nitrogen service, consisting of a line pressure control regulator, outlet line pressure gage, DISS service outlet, and supply valve, assembled and rigidly mounted in a roughing-in assembly, and provided with a metal cover plate. Panel shall be designed to deliver 10 L/s (20 SCFM) at 1535 kPa (223 psi). Unit may be recessed wall mounted or integral with the articulating arm or column with individual regulators for each outlet.
- B. Manifold Assembly: Mounted to a steel support bracket, factory assembled and tested, ready for installation in the roughing-in assembly.
  - 1. Supply valve, bronze bodied, double seal, full flow, ball type, designed for working pressure in excess of 1700 kPa (300) psi, with chrome plated brass ball which seals in both directions, requiring only a quarter turn of the knob from open to closed position.
  - 2. Line pressure control regulator, self-relieving, diaphragm type, with high-flow precision adjustment and working pressure in excess of 1700 kPa (250 psi).
  - 3. Line pressure gage, to monitor the gas outlet line pressure, calibrated from 0 to 2000 kPa (300 psi) in increments of 100 kPa (10 psi).
  - 4. Nitrogen service outlet, DISS type as specified under Article, STATION OUTLETS, with a self-sealing dust plug, having a working pressure of 1700 kPa (250 psi) maximum.
  - 5. Two 146 mm (5-3/4 inch) lengths of 10 mm (3/8-inch) outside diameter type "K" copper tubing for connection to gas service supply line and to remote outlet line.
- C. Roughing-In Assembly: Designed for recessed installation, consisting of a prime painted steel fabricated back box with mounting flanges on all four sides, with provisions to securely anchor the back box to wall construction. Equip with a crossover "U" tube to facilitate testing of the nitrogen system prior to the manifold installation, and a plaster shield to prevent dust or other foreign matter from contaminating internal parts prior to final assembly.
- D. Cover plate Assembly: Chromed cast metal or NAAMM Number 4 satin finished stainless steel panel with provisions for line pressure gage(s), nitrogen outlet, regulator and supply valve knobs, attaching directly to the roughing-in assembly by means of four Number 6 - 32 by 40 mm (1-1/2 inch) long mounting screws, with plaster adjustments up to 20 mm (3/4 inch).

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- B. Keep open ends of tube capped or plugged at all times or otherwise sealed until final assembly.
- C. Cut piping square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. Ream tube to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. Work into place without springing or forcing. Bottom tube in socket so there are no gaps between tube and fitting. Exercise care in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease being introduced into tubing. Where contamination has occurred, material is no longer suitable for oxygen service.
- D. Spacing of hangers: Current NFPA.
- E. Rigidly support valves and other equipment to prevent strain on tube or joints.
- F. While being brazed, joints shall be continuously purged with *oil* free nitrogen. The flow of purged gas shall be maintained until joint is cool to touch.
- G. Do not bend tubing. Use fittings.
- H. Install pressure switches, transmitter and gauges to be easily accessed, and provide access panel where installed above plaster ceiling. Install pressure switch and sensors with orifice nipple between the pipe line and switches/sensors.
- I. Apply pipe labeling during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.
- J. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.
- K. Penetrations:
  - 1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with intumescent materials only. Completely fill and seal clearances between raceways and openings with the fire stopping material.



2. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

L. Provide 40mm (1 1/2 inch) diameter line pressure gage downstream of zone valve in cabinets.

M. Provide zone valves in cabinets where indicated and outside each Operating Room and a minimum one zone valve assembly for each 18 outlet set.

### 3.2 TESTS

A. Initial Tests: Blow down, and high and low pressure leakage tests as required by current NFPA with documentation.

B. Laboratory and healthcare testing agency shall perform the following:

1. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.

2. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.

3. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.

4. Piping purity test: For each positive pressure system, verify purity of piping system. Test each zone at the most remote outlet for dew point, carbon monoxide, total hydrocarbons (as methane), and halogenated hydrocarbons, and compare with source gas. The two tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Perform test with the use of an inert gas as described in CGA P-9.

5. Outlet and inlet flow test:

a. Test all outlets for flow. Perform test with the use of an inert gas as described in CGA P-9.

b. Oxygen, nitrous oxide and air outlets must deliver 100 Lpm (3.5 scfm) with a pressure drop of no more than 35 kPa (5 psi), and static pressure of 350 kPa (50 psi).

c. Nitrogen outlets must deliver 565 Lpm (20 scfm) with a pressure

drop of no more than 35 kPa (5 psi), and static pressure of 1445 kPa (210 psi).

- d. Needle valve air outlets must deliver 1.5 scfm with a pressure drop of no more than five psi, and static pressure of 50 psi.

6. Analysis Test:

- a. Analyze each pressure gas source and outlet for concentration of gas, by volume.
- b. Make analysis with instruments designed to measure the specific gas dispensed.
- c. Allowable concentrations are within the following:
- 1) Laboratory air 19.5 percent to 23.5 percent oxygen.

Oxygen	99 plus percent oxygen
Nitrous oxide	99 plus percent nitrous oxide
Nitrogen	99 plus percent nitrogen
Medical air	19.5 percent to 23.5 percent oxygen
Carbon Dioxide	99 plus percent carbon dioxide

7. Maximum Allowable Variation: Between comparative test results required are as follows:

Dew point	2 degrees C (4 degrees F)
Carbon monoxide	2 mg/L (ppm)
Total hydrocarbons as methane	1 mg/L (ppm)
Halogenated hydrocarbons	2 mg/L (ppm)

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**SECTION 23 05 11**  
**COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 23.
- B. Definitions:
  - 1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
  - 2. Option or optional: Contractor's choice of an alternate material or method.
  - 3. COR: Contracting Officer's Representative.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 07 84 00, FIRESTOPPING.
- D. Section 07 92 00, JOINT SEALANTS.

**1.3 QUALITY ASSURANCE**

- A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC or steam boiler plant construction, as applicable.
- B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- C. Equipment Vibration Tolerance:
  - 1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.
  - 2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.
- D. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the COR.
4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

E. Equipment Service Organizations:

1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located reasonably close to the site.
2. Boiler Plants: Service organizations, authorized and trained by manufacturers of the equipment supplied, shall be located within 100 miles of the project. These organizations shall come to the site and provide acceptable service to restore boiler plant operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within

24 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): burners, burner control systems, boiler control systems, pumps, critical instrumentation, computer workstation and programming.

- F. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
  2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
  3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- G. Execution (Installation, Construction) Quality:
1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the COR for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the COR at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
  2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract drawings to the COR for resolution.
  3. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and with requirements in the individual specification sections.
- B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- E. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.
- F. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- G. Samples: Samples will not be required, except for insulation or where materials offered differ from specification requirements. Samples shall be accompanied by full description of characteristics different from specification. The Government, at the Government's expense, will perform evaluation and testing if necessary. The Contractor may submit samples of additional material at the Contractor's option; however, if additional samples of materials are submitted later, pursuant to Government request, adjustment in contract price and time will be made as provided in the GENERAL CONDITIONS.
- H. Layout Drawings:
  - 1. Submit complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Refer to the GENERAL CONDITIONS.

2. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed layout drawings of all piping and duct systems.
  3. Do not install equipment foundations, equipment or piping until layout drawings have been approved.
  4. In addition, for HVAC systems, provide details of the following:
    - a. Mechanical equipment rooms.
    - b. Interstitial space.
    - c. Hangers, inserts, supports, and bracing.
    - d. Pipe sleeves.
    - e. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- I. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the COR.
  2. Submit electric motor data and variable speed drive data with the driven equipment.
  3. Equipment and materials identification.
  4. Fire-stopping materials.
  5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers. For boiler plants, refer to Section 23 21 11, BOILER PLANT PIPING SYSTEMS, for additional requirements.
  6. Wall, floor, and ceiling plates.
- J. HVAC Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
  2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

K. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

#### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (ARI):  
430-99.....Central Station Air-Handling Units
- C. American National Standard Institute (ANSI):  
B31.1-2004.....Power Piping
- D. Rubber Manufacturers Association (ANSI/RMA):  
IP-20-2007.....Drives Using Classical V-Belts and Sheaves  
IP-21-1991(1997).....Drives Using Double-V (Hexagonal) Belts  
IP-22-2007.....Drives Using Narrow V-Belts and Sheaves
- E. Air Movement and Control Association (AMCA):  
410-96.....Recommended Safety Practices for Air Moving Devices
- F. American Society of Mechanical Engineers (ASME):  
Boiler and Pressure Vessel Code (BPVC):  
Section I-2007.....Power Boilers  
Section IX-2007.....Welding and Brazing Qualifications  
Code for Pressure Piping:  
B31.1-2004.....Power Piping, with Amendments
- G. American Society for Testing and Materials (ASTM):  
A36/A36M-05.....Carbon Structural Steel  
A575-96(2002).....Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)  
E84-07.....Standard Test Method for Burning Characteristics of Building Materials  
E119-07.....Standard Test Method for Fire Tests of Building Construction and Materials
- H. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:  
SP-58-2002.....Pipe Hangers and Supports-Materials, Design and Manufacture  
SP 69-2003.....Pipe Hangers and Supports-Selection and Application  
SP 127-2001.....Bracing for Piping Systems, Seismic - Wind - Dynamic, Design, Selection, Application



J. National Electrical Manufacturers Association (NEMA):

MG-1-2006.....Motors and Generators

K. National Fire Protection Association (NFPA):

31-06.....Standard for Installation of Oil-Burning  
Equipment

54-06.....National Fuel Gas Code

70-08.....National Electrical Code

85-07.....Boiler and Combustion Systems Hazard Code

90A-02.....Installation of Air Conditioning and Ventilating  
Systems

101-06.....Life Safety Code

**1.6 DELIVERY, STORAGE AND HANDLING**

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Place damaged equipment in first class, new operating condition; or replace same as determined and directed by the COR. Such repair or replacement shall be at no additional cost to the Government.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

**PART 2 - PRODUCTS**

**2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. Provide maximum standardization of components to reduce spare part requirements.

- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
  - 1. All components of an assembled unit need not be products of same manufacturer.
  - 2. Constituent parts that are alike shall be products of a single manufacturer.
  - 3. Components shall be compatible with each other and with the total assembly for intended service.
  - 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

## **2.2 COMPATIBILITY OF RELATED EQUIPMENT**

Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

## **2.3 BELT DRIVES**

- A. Type: ANSI/RMA standard V-belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.
- B. Dimensions, rating and selection standards: ANSI/RMA IP-20 and IP-21.
- C. Minimum Horsepower Rating: Motor horsepower plus recommended ANSI/RMA service factor (not less than 20 percent) in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact.
- D. Maximum Speed: 25 m/s (5000 feet per minute).
- E. Adjustment Provisions: For alignment and ANSI/RMA standard allowances for installation and take-up.
- F. Drives may utilize a single V-Belt (any cross section) when it is the manufacturer's standard.
- G. Multiple Belts: Matched to ANSI/RMA specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.

H. Sheaves and Pulleys:

1. Material: Pressed steel, or close grained cast iron.
2. Bore: Fixed or bushing type for securing to shaft with keys.
3. Balanced: Statically and dynamically.
4. Groove spacing for driving and driven pulleys shall be the same.
5. Minimum Diameter of V-Belt Sheaves (ANSI/RMA recommendations) in millimeters and inches:

Fractional Horsepower		Standard		High Capacity	
Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)	Cross Section	Min. od mm (in)
2L	20 (0.8)	A	83 (3.25)	3V	67 (2.65)
3L	38 (1.5)	B	146 (5.75)	4V	180 (7.10)
4L	64 (2.5)	C	239 (9.40)	5V	318 (12.50)
5L	89 (3.5)	D	345 (13.60)		
		E	554 (21.80)		

I. Drive Types, Based on ARI 435:

1. Provide adjustable-pitch or fixed-pitch drive as follows:
  - a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
  - b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
2. Provide fixed-pitch drives for drives larger than those listed above.
3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

**2.4 DRIVE GUARDS**

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory fabricated air handling unit casings.
- B. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 6 mm (1/4-inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

- C. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gage sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (one-inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.
- D. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.
- E. Access for Speed Measurement: 25 mm (One inch) diameter hole at each shaft center.

## **2.5 LIFTING ATTACHMENTS**

Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

## **2.6 EQUIPMENT AND MATERIALS IDENTIFICATION**

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.
- D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
  - 1. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm(1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
  - 2. Valve lists: Typed or printed plastic coated card(s), sized 216 mm(8-1/2 inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.

3. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

## **2.7 FIRESTOPPING**

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION, for firestop pipe and duct insulation.

## **2.8 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

- A. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.
- B. Attachment to Concrete Building Construction:
  1. Concrete insert: MSS SP-58, Type 18.
  2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the COR for each job condition.
  3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (four inches) thick when approved by the COR for each job condition.
- C. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- D. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
  1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
  2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2-inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

E. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping.  
Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
2. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
  - a. Standard clevis hanger: Type 1; provide locknut.
  - b. Riser clamps: Type 8.
  - c. Wall brackets: Types 31, 32 or 33.
  - d. Roller supports: Type 41, 43, 44 and 46.
  - e. Saddle support: Type 36, 37 or 38.
  - f. Turnbuckle: Types 13 or 15. Preinsulate.
  - g. U-bolt clamp: Type 24.
  - h. Copper Tube:
    - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non adhesive isolation tape to prevent electrolysis.
    - 2) For vertical runs use epoxy painted or plastic coated riser clamps.
    - 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
    - 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
  - i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.

J. Pre-insulated Calcium Silicate Shields:

1. Provide 360 degree water resistant high density 965 kPa (140 psi) compressive strength calcium silicate shields encased in galvanized metal.
2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
3. Shield thickness shall match the pipe insulation.
4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.

- a. Shields for supporting chilled or cold water shall have insulation that extends a minimum of 1 inch past the sheet metal. Provide for an adequate vapor barrier in chilled lines.
  - b. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields may have one or more of the following features: structural inserts 4138 kPa (600 psi) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.
5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.

## **2.9 PIPE PENETRATIONS**

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
  - 1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
  - 2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
  - 3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COR.
- D. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- E. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
- F. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

## **2.10 SPECIAL TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the COR, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- D. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

## **2.11 WALL, FLOOR AND CEILING PLATES**

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

## **2.12 ASBESTOS**

Materials containing asbestos are not permitted.

## **PART 3 - EXECUTION**

### **3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING**

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Submit the drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.



- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.
- C. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- D. Cutting Holes:
1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.
  2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
  3. Do not penetrate membrane waterproofing.
- E. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- F. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- G. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- H. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.
  2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective

grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

I. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

J. Work in Existing Building:

1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the COR. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the COR for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After COR's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.

K. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

### **3.2 TEMPORARY PIPING AND EQUIPMENT**

- A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Para. 3.1 apply.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

### **3.3 RIGGING**

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to COR for evaluation prior to actual work.
- G. Restore building to original condition upon completion of rigging work.

### **3.4 PIPE AND EQUIPMENT SUPPORTS**

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend

the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the RE/COTR.

- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.
- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.
- E. HVAC Vertical Pipe Supports:
  - 1. Up to 150 mm (6-inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
  - 2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.
- F. Overhead Supports:
  - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
  - 2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
  - 3. Tubing and capillary systems shall be supported in channel troughs.
- G. Floor Supports:
  - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
  - 2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 150 mm (6 inches) on all sides. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.

3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.

### **3.5 MECHANICAL DEMOLITION**

- A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Do not permit debris to accumulate in the area to the detriment of plant operation. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VA Medical Center, and Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment,

devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

### **3.6 CLEANING**

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned.
- B. In addition, the following special conditions apply:
  - 1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
  - 2. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.

### **3.7 IDENTIFICATION SIGNS**

- A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.
- C. Boiler Plant Instrumentation Panel: Refer to Section 23 09 11, .
- D. Boiler Control Panels: Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT
- E. Pipe Identification: Refer to Section 09 91 00, PAINTING.

### **3.8 MOTOR AND DRIVE ALIGNMENT**

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

### **3.9 LUBRICATION**

- A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.

- B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to COR in unopened containers that are properly identified as to application.
- C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

### **3.10 STARTUP AND TEMPORARY OPERATION**

Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

### **3.11 OPERATING AND PERFORMANCE TESTS**

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS, and Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT, and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

### **3.12 INSTRUCTIONS TO VA PERSONNEL**

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS

- - - E N D - - -

**SECTION 23 05 93**  
**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:
  - 1. Planning systematic TAB procedures.
  - 2. Design Review Report.
  - 3. Systems Inspection report.
  - 4. Duct Air Leakage test report.
  - 5. Systems Readiness Report.
  - 6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
  - 7. Recording and reporting results.
- B. Definitions:
  - 1. Basic TAB used in this Section: Chapter 37, "Testing, Adjusting and Balancing" of ASHRAE Handbook, "HVAC Applications".
  - 2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
  - 3. AABC: Associated Air Balance Council.
  - 4. NEBB: National Environmental Balancing Bureau.
  - 5. Hydronic Systems: Includes heating hot water
  - 6. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
  - 7. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

**1.2 RELATED WORK**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General Mechanical Requirements.
- B. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Piping and Equipment Insulation.
- C. Section 23 36 00, AIR TERMINAL UNITS: Terminal Units Performance.
- D. Section 23 31 00, HVAC DUCTS AND CASINGS: Duct Leakage.



E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Controls and Instrumentation Settings.

### **1.3 QUALITY ASSURANCE**

A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

B. Qualifications:

1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the COR and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
3. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the COR and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB

specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.

4. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the COR. The responsibilities would specifically include:
    - a. Shall directly supervise all TAB work.
    - b. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB.
    - c. Would follow all TAB work through its satisfactory completion.
    - d. Shall provide final markings of settings of all HVAC adjustment devices.
    - e. Permanently mark location of duct test ports.
  5. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing.
- C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.
- D. Tab Criteria:
1. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.
  2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36, as a guideline. Air Filter resistance

- during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.
- a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 0 percent to plus 10 percent.
  - b. Air terminal units (maximum values): Minus 2 percent to plus 10 percent.
  - c. Exhaust hoods/cabinets: 0 percent to plus 10 percent.
  - d. Minimum outside air: 0 percent to plus 10 percent.
  - e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 2 percent to plus 10 percent except if the air to a space is 100 CFM or less the tolerance would be 0 to plus 5 percent.
  - f. Heating hot water pumps and hot water coils: Minus 5 percent to plus 5 percent.
3. Systems shall be adjusted for energy efficient operation as described in PART 3.
  4. Typical TAB procedures and results shall be demonstrated to the COR for one air distribution system (including all fans, three terminal units, three rooms) and one hydronic system (pumps and three coils) as follows:
    - a. When field TAB work begins.
    - b. During each partial final inspection and the final inspection for the project if requested by VA.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.
- C. For use by the COR staff, submit one complete set of applicable AABC or NEBB publications that will be the basis of TAB work.
- D. Submit Following for Review and Approval:
  1. Design Review Report within 90 days for conventional design projects after the system layout on air and water side is completed by the Contractor.

2. Systems inspection report on equipment and installation for conformance with design.
  3. Duct Air Leakage Test Report.
  4. Systems Readiness Report.
  5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
  6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
- E. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):  
2003.....HVAC Applications ASHRAE Handbook, Chapter 37,  
Testing, Adjusting, and Balancing and Chapter  
47, Sound and Vibration Control
- C. Associated Air Balance Council (AABC):  
2002.....AABC National Standards for Total System  
Balance
- D. National Environmental Balancing Bureau (NEBB):  
7<sup>th</sup> Edition 2005 .....Procedural Standards for Testing, Adjusting,  
Balancing of Environmental Systems  
1<sup>st</sup> Edition 1994 .....Procedural Standards for the Measurement and  
Assessment of Sound and Vibration  
2<sup>nd</sup> Edition 1999 .....Procedural Standards for Building Systems  
Commissioning
- E. Sheet Metal and Air Conditioning Contractors National Association  
(SMACNA):  
3<sup>rd</sup> Edition 2002 .....HVAC SYSTEMS-Testing, Adjusting and Balancing

## **PART 2 - PRODUCTS**

### **2.1 PLUGS**

Provide plastic plugs to seal holes drilled in ductwork for test purposes.

### **2.2 INSULATION REPAIR MATERIAL**

See Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.  
Provide for repair of insulation removed or damaged for TAB work.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Refer to TAB Criteria in Article, Quality Assurance.
- B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

### **3.2 DESIGN REVIEW REPORT**

The TAB Specialist shall review the Contract Plans and specifications and advise the COR of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

### **3.3 SYSTEMS INSPECTION REPORT**

- A. Inspect equipment and installation for conformance with design.
- B. The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.
- C. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

#### **3.4 DUCT AIR LEAKAGE TEST REPORT**

See paragraphs "Duct leakage Tests and Repairs" in Section 23 31 00, HVAC DUCTS AND CASINGS for TAB agency's role and responsibilities in witnessing, recording and reporting of deficiencies.

#### **3.5 SYSTEM READINESS REPORT**

- A. Inspect each System to ensure that it is complete including installation and operation of controls.
- B. Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the COR.

#### **3.6 TAB REPORTS**

- A. Submit an intermediate report for 50 percent of systems and equipment tested and balanced to establish satisfactory test results.
- B. The TAB contractor shall provide raw data immediately in writing to the COR if there is a problem in achieving intended results before submitting a formal report.
- C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated and re-submitted for approval.
- D. Do not proceed with the remaining systems until intermediate report is approved by the COR.

#### **3.7 TAB PROCEDURES**

- A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.
- B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.
- C. Coordinate TAB procedures with any phased construction completion requirements for the project. Provide TAB reports for each phase of the project prior to partial final inspections of each phase of the project.

- D. Allow sufficient time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.
- E. Air Balance and Equipment Test: Include air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets, computer room AC units, and laboratory fume hoods and cabinets.
  - 1. Artificially load air filters by partial blanking to produce air pressure drop of at least 90 percent of the design final pressure drop.
  - 2. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
  - 3. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.
  - 4. Variable air volume (VAV) systems:
    - a. Coordinate TAB, including system volumetric controls, with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
    - b. Section 23 36 00, AIR TERMINAL UNITS, specifies that maximum and minimum flow rates for air terminal units (ATU) be factory set. Check and readjust ATU flow rates if necessary. Balance air distribution from ATU on full cooling maximum scheduled cubic meters per minute (cubic feet per minute). Reset room thermostats and check ATU operation from maximum to minimum cooling, to the heating mode, and back to cooling. Record and report the heating coil leaving air temperature when the ATU is in the maximum heating mode.
  - 5. Record final measurements for air handling equipment performance data sheets.
- F. Water Balance and Equipment Test: Include circulating pumps, convertors, coils, coolers and condensers:
  - 1. Adjust flow rates for equipment. Set coils and evaporator to values on equipment submittals, if different from values on contract drawings.
  - 2. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating

and cooling coils, and for convertors. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

### **3.8 MARKING OF SETTINGS**

Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the COR.

### **3.9 IDENTIFICATION OF TEST PORTS**

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

- - - E N D - - -



**SECTION 23 07 11**  
**HVAC AND BOILER PLANT INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Field applied insulation for thermal efficiency and condensation control for
  - 1. HVAC piping, ductwork and equipment.
- B. Definitions
  - 1. ASJ: All service jacket, white finish facing or jacket.
  - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
  - 3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
  - 4. Concealed: Ductwork and piping above ceilings and in chases, interstitial space, and pipe spaces.
  - 5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases, interstitial spaces, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
  - 6. FSK: Foil-scrim-kraft facing.
  - 7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F); HVAC equipment or piping handling media above 41 degrees C (105 degrees F)
  - 8. Density: kg/m<sup>3</sup> - kilograms per cubic meter (Pcf - pounds per cubic foot).
  - 9. Runouts: Branch pipe connections up to 25-mm (one-inch) nominal size to fan coil units or reheat coils for terminal units.
  - 10. Thermal conductance: Heat flow rate through materials.
    - a. Flat surface: Watt per square meter (BTU per hour per square foot).
    - b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).

11. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
13. HPS: High pressure steam (415 kPa [60 psig] and above).
14. HPR: High pressure steam condensate return.
15. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig]).
16. MPR: Medium pressure steam condensate return.
17. LPS: Low pressure steam (103 kPa [15 psig] and below).
18. LPR: Low pressure steam condensate gravity return.
19. PC: Pumped condensate.
20. HWH: Hot water heating supply.
21. HWHR: Hot water heating return.
22. GH: Hot glycol-water heating supply.
23. GHR: Hot glycol-water heating return.
24. CW: Cold water.
25. SW: Soft water.
26. HW: Hot water.
27. CH: Chilled water supply.
28. CHR: Chilled water return.
29. GC: Chilled glycol-water supply.
30. GCR: Chilled glycol-water return.
31. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

## **1.2 RELATED WORK**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- D. Section 23 21 13, HYDRONIC PIPING.

### 1.3 QUALITY ASSURANCE

A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC

B. Criteria:

1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

**4.3.3.1** Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.1 or 4.3.3.1.2., shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

**4.3.3.1.1** Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2.)

**4.3.3.1.2** The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

**4.3.3.2** Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

(1) UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors

(2) UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

**4.3.3.3** Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

**4.3.3.3.1** In no case shall the test temperature be below 121°C (250°F).

**4.3.3.4** Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a

fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.5\* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

(1) Not exceeding a 25.4 mm (1 in.) average clearance on all sides

(2) Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*

2. Test methods: ASTM E84, UL 723, or NFPA 255.

3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Shop Drawings:
  1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
    - a. Insulation materials: Specify each type used and state surface burning characteristics.
    - b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
    - c. Insulation accessory materials: Each type used.
    - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
    - e. Make reference to applicable specification paragraph numbers for coordination.
- C. Samples:
  1. Each type of insulation: Minimum size 100 mm (4 inches) square for board/block/ blanket; 150 mm (6 inches) long, full diameter for round types.
  2. Each type of facing and jacket: Minimum size 100 mm (4 inches square).
  3. Each accessory material: Minimum 120 ML (4 ounce) liquid container or 120 gram (4 ounce) dry weight for adhesives / cement / mastic.

#### **1.5 STORAGE AND HANDLING OF MATERIAL**

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers.

Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

#### 1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):  
L-P-535E (2)- 99.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. Military Specifications (Mil. Spec.):  
MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation  
MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic Thermal Insulation  
MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier  
MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
- D. American Society for Testing and Materials (ASTM):  
A167-99(2004).....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip  
B209-07.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate  
C411-05.....Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation  
C449-07.....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement  
C533-09.....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

- C534-08.....Standard Specification for Preformed Flexible  
Elastomeric Cellular Thermal Insulation in  
Sheet and Tubular Form
- C547-07.....Standard Specification for Mineral Fiber pipe  
Insulation
- C552-07.....Standard Specification for Cellular Glass  
Thermal Insulation
- C553-08.....Standard Specification for Mineral Fiber  
Blanket Thermal Insulation for Commercial and  
Industrial Applications
- C585-09.....Standard Practice for Inner and Outer Diameters  
of Rigid Thermal Insulation for Nominal Sizes  
of Pipe and Tubing (NPS System) R (1998)
- C612-10.....Standard Specification for Mineral Fiber Block  
and Board Thermal Insulation
- C1126-04.....Standard Specification for Faced or Unfaced  
Rigid Cellular Phenolic Thermal Insulation
- C1136-10.....Standard Specification for Flexible, Low  
Permeance Vapor Retarders for Thermal  
Insulation
- D1668-97a (2006).....Standard Specification for Glass Fabrics (Woven  
and Treated) for Roofing and Waterproofing
- E84-10.....Standard Test Method for Surface Burning  
Characteristics of Building  
Materials
- E119-09c.....Standard Test Method for Fire Tests of Building  
Construction and Materials
- E136-09b.....Standard Test Methods for Behavior of Materials  
in a Vertical Tube Furnace at 750 degrees C  
(1380 F)
- E. National Fire Protection Association (NFPA):
- 90A-09.....Standard for the Installation of Air  
Conditioning and Ventilating Systems
- 96-08.....Standards for Ventilation Control and Fire  
Protection of Commercial Cooking Operations

101-09.....Life Safety Code  
251-06.....Standard methods of Tests of Fire Endurance of  
Building Construction Materials  
255-06.....Standard Method of tests of Surface Burning  
Characteristics of Building Materials

F. Underwriters Laboratories, Inc (UL):

723.....UL Standard for Safety Test for Surface Burning  
Characteristics of Building Materials with  
Revision of 09/08

G. Manufacturer's Standardization Society of the Valve and Fitting  
Industry (MSS):

SP58-2009.....Pipe Hangers and Supports Materials, Design,  
and Manufacture

**PART 2 - PRODUCTS**

**2.1 TECHLITE ISULATION OR APPROVED EQUAL (note: this was previously shown as  
bid option #7 for phase 1 scope - now considered as base bid for phase 2)**

- A. Preformed (molded) flexible open cell melamine pipe insulation, ASTM C-1410, for temperatures between -40 degrees F and 350 degrees F. Include 4 oz kraft paper/foil laminate service jacket with fiberglass reinforcement. Mechanical Contractor to include within base bid pricing for this product to be utilized for all heating water piping associated with VAV boxes.
- B. Sheets of flexible open cell melamine duct insulation, with all purpose kraft scrim foil facing, used for all supply, return, and exhaust ductwork within interstitial space. Mechanical Contractor to provide pricing within base bid to replace all fiberglass duct wrap insulation with this alternative material.
- C. Thermal Conductivity: 0.25" btu per in/hr\*ft<sup>2</sup>
- D. Density: 0.56 +/- 0.06 lb/ft<sup>3</sup>
- E. Flame spread/Smoke development: 25/50 per ASTM E84

**2.2 MINERAL FIBER OR FIBER GLASS**

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m<sup>3</sup> (3 pcf), k = 0.037 (0.26) at 24 degrees C (75 degrees F), external insulation for



temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.

- B. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 16 kg/m<sup>3</sup> (1 pcf), k = 0.045 (0.31) at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

### 2.3 CELLULAR GLASS CLOSED-CELL

- A. Comply with Standard ASTM C177, C518, density 120 kg/m<sup>3</sup> (7.5 pcf) nominal, k = 0.033 (0.29) at 24 degrees C (75 degrees F).
- B. Pipe insulation for use at temperatures up to 200 degrees C (400 degrees F) with all service vapor retarder jacket.

### 2.4 CALCIUM SILICATE

- A. Preformed pipe Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- B. Premolded Pipe Fitting Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- C. Equipment Insulation: ASTM C533, Type I and Type II
- D. Characteristics:

Insulation Characteristics		
ITEMS	TYPE I	TYPE II
Temperature, maximum degrees C (degrees F)	649 (1200)	927 (1700)
Density (dry), Kg/m <sup>3</sup> (lb/ ft <sup>3</sup> )	232 (14.5)	288 (18)
Thermal conductivity: Min W/ m K (Btu in/h ft <sup>2</sup> degrees F)@ mean temperature of 93 degrees C (200 degrees F)	0.059 (0.41)	0.078 (0.540)
Surface burning characteristics:		

Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

## 2.5 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance  $\leq 0.02$  or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.

## 2.6 PIPE COVERING PROTECTION SADDLES

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m<sup>3</sup> (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high

density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m<sup>3</sup> (3.0 pcf).

## **2.7 ADHESIVE, MASTIC, CEMENT**

- A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.
- E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.
- F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
- G. Other: Insulation manufacturers' published recommendations.

## **2.8 MECHANICAL FASTENERS**

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- O. Bands: 13 mm (0.5 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

## **2.9 REINFORCEMENT AND FINISHES**

- A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.
- E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.

F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

#### **2.10 FLAME AND SMOKE**

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

### **PART 3 - EXECUTION**

#### **3.1 GENERAL REQUIREMENTS**

- A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

- E. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- F. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
- G. HVAC work not to be insulated:
  - 1. Internally insulated ductwork and air handling units.
  - 2. Relief air ducts (Economizer cycle exhaust air).
  - 3. Exhaust air ducts and plenums, and ventilation exhaust air shafts.
  - 4. Equipment: Expansion tanks, flash tanks, hot water pumps
  - 5. In hot piping: Unions, flexible connectors, control valves, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.
- H. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- I. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. // The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting.// Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- J. Firestop Pipe and Duct insulation:
  - 1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed.
  - 2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
    - a. Pipe risers through floors
    - b. Pipe or duct chase walls and floors
    - c. Smoke partitions
    - d. Fire partitions

### 3.2 INSULATION INSTALLATION

#### A. Mineral Fiber Board:

1. Faced board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
2. Plain board:
  - a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9 inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
  - b. For hot equipment: Stretch 25 mm (1 inch) mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 6 mm (1/4 inch) thick, trowel led to a smooth finish.
  - c. For cold equipment: Apply meshed glass fabric in a tack coat 1.5 to 1.7 square meter per liter (60 to 70 square feet per gallon) of vapor mastic and finish with mastic at 0.3 to 0.4 square meter per liter (12 to 15 square feet per gallon) over the entire fabric surface.

#### B. Flexible Mineral Fiber Blanket or Techlite:

1. Adhere insulation to metal with 75 mm (3 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.

2. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To prevent condensation insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.
  3. Concealed supply air ductwork.
    - a. Above ceilings at a roof level, in attics, and duct work exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with FSK.
    - b. Above ceilings for other than roof level: 40 mm (1 ½ inch) thick insulation faced with FSK.
  4. Concealed return air duct:
    - a. In interstitial spaces (where not subject to damage): 40 mm (1-1/2 inch thick insulation faced with FSK.
    - b. Concealed return air ductwork in other locations need not be insulated.
  5. Concealed outside air duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.
  6. Exhaust air branch duct from autopsy refrigerator to main duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.
- C. Molded Mineral Fiber Pipe and Tubing Covering:
1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
  2. Contractor's options for fitting, flange and valve insulation:
    - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.

- b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
  - c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
  - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

D. Cellular Glass Insulation:

- 1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
- 2. Underground Piping Other than or in lieu of that Specified in Section 23 21 13, HYDRONIC PIPING and Section 33 63 00, STEAM ENERGY DISTRIBUTION: Type II, factory jacketed with a 3 mm laminate jacketing consisting of 3000 mm x 3000 mm (10 ft x 10 ft) asphalt impregnated glass fabric, bituminous mastic and outside protective plastic film.
  - a. 75 mm (3 inches) thick for hot water piping.
  - b. As scheduled at the end of this section for chilled water piping.
  - c. Underground piping: Apply insulation with joints tightly butted. Seal longitudinal self-sealing lap. Use field fabricated or factory made fittings. Seal butt joints and fitting with jacketing as recommended by the insulation manufacturer. Use 100 mm (4 inch) wide strips to seal butt joints.
  - d. Provide expansion chambers for pipe loops, anchors and wall penetrations as recommended by the insulation manufacturer.



- e. Underground insulation shall be inspected and approved by the Resident Engineer as follows:
  - 1) Insulation in place before coating.
  - 2) After coating.
- f. Sand bed and backfill: Minimum 75 mm (3 inches) all around insulated pipe or tank, applied after coating has dried.
- 3. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ for chilled water pumps, water filters, chemical feeder pots or tanks, expansion tanks, air separators and air purgers.
- 4. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a reinforcing membrane and two coats of vapor barrier mastic or multi-layer vapor barrier with a water vapor permeability of 0.00 perms.

### 3.7 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

### 3.8 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature Range/Service	Insulation Material	Less than 25 (1)	25 - 32 (1 - 1½)	38 - 75 (1½ - 3)	100 (4) and Above
122-177 degrees C (251-350 degrees F)	Technlite Insulation (Above ground	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)

(HPS, MPS)	piping only)				
38-94 degrees C (100-200 degrees F) (LPR, PC, GH and GHR)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Cellular Glass Closed- Cell	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)

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**SECTION 23 08 00**  
**COMMISSIONING OF HVAC SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 23.
- B. This project will have selected building systems commissioned. The commissioning process, which the Contractor is responsible to assist execute, will include general performance verification of all new systems installed within this project. Dunham will be the assigned Commissioning Agent (CxA) contracted directly through the VA.
- C. Mechanical Contractor Responsibilities: Include adequate budget within their bids to assist with all commissioning service activities. Contractor should be aware that any management, and/or commissioning participation efforts, required by any sub-contracts or specialty equipment manufacturers should also be contained within their base bid pricing. However, there is no additional allowance required to be allocated for the Commissioning Agent.
- D. Commissioning Agent Responsibilities: Commission Agent must submit a comprehensive work plan for approval. Mechanical Contractor to review commissioning plan and set up time/date(s) where all the affected subcontractors will be available for participation. Contractual relationship will be directly between Commissioning Agent and VA.

**1.2 RELATED WORK**

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

**1.3 SUMMARY**

- A. This Section includes requirements for commissioning the Facility related subsystems and new equipment.

**1.4 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

### **1.5 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Division 23, is required in cooperation with the VA and the Commissioning Agent.

### **1.6 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process may require Submittal review simultaneously with engineering review.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 CONSTRUCTION INSPECTIONS**

- A. Commissioning of HVAC systems will require inspection of individual elements of the HVAC systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with the Commissioning plan to schedule HVAC systems inspections as required to support the Commissioning Process.

#### **3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the

Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission.

### **3.3 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### **3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed.

### **3.5 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor

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shall submit training agendas and trainer resumes in accordance with the requirements of facility. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Division 23 Sections for additional Contractor training requirements.

----- END -----

SECTION 23 09 23  
BUILDING AUTOMATION SYSTEM FOR HVAC

**Part 1 - General**

**1.1 Related Documents**

- A. All work of this Division shall be coordinated and provided by the single Building Automation System (BAS) Contractor.
- B. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- C. If the BAS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

**1.2 Definitions**

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level.
- C. Building Automation System (BAS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BAS Contractor and to be interfaced to the associated work of other related trades.
- D. BAS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BAS work.
- E. Control Sequence: An BAS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BAS Network: The total digital on-line real-time interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BAS network.
- I. BAS Integration: The complete functional and operational interconnection and interfacing of all BAS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BAS as required by this Division.

- J. Provide: The term "Provide" and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- K. PC: IBM-compatible Personal Computer from a recognized major manufacturer
- L. Furnish: The term "Furnish" and its derivatives when used in this Division shall mean supply at the BAS Contractor's cost to the designated third party trade contractor for installation. BAS Contractor shall connect furnished items to the BAS, calibrate, test, commission, warrant and document.
- M. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the BAS wiring and terminations.
- N. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- O. Protocol: The term "protocol" and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BAS network nodes.
- P. Software: The term "software" and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.
- Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.

### **1.3. BAS Description**

- A. The BAS ADX primary, backup servers, and the NAEs at the Mpls VAMC reside on the bio-med network. There are dedicated workstations and laptops that have direct access to the BAS. No attempts to connect JCI laptops or off-the-shelf PCs to any VAMC network should ever be made.
- B. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BAS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.
- C. The work of the single BAS Contractor shall be as defined individually and collectively in all Sections of this specification and the associated interfacing work as referenced in the related documents.
- D. The BAS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though



these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BAS. Software shall be included, as necessary, to make new BAS components integrate with existing system. At a minimum, this would consist of CCT folder with all the caf files. The NAE point schedule shall also be included directly in the software folder.

- E. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- F. Manage and coordinate the BAS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
- G. New equipment that will communicate with METASYS shall use BACnet MS/TP communications protocol. BACnet MS/TP allows IP addresses to be shared, rather than using a separate IP address for each piece of equipment.
- H. Access to the bio-med and/or enterprise network requires:
  - 1. NAC(I) Clearance: Contact the COR to initiate the process of obtaining clearance.
  - 2. IT/Cyber Security Training: Contact the COR to initiate the training. The link is <https://www.ees-learning.net/librix/loginhtml.asp?v=librix>.

#### **1.4 Quality Assurance**

- A. The BAS Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Automation Systems.
- B. The BAS Contractor shall be a recognized national manufacturer, installer and service provider of BAS.
- C. The BAS Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
- D. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BAS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
- E. The BAS architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Automation Systems, and shall be the manufacturer's latest standard of design at the time of bid.

### 1.5 Work By Others

A. The demarcation of work and responsibilities between the BAS Contractor and other related trades shall be as outlined in the BAS RESPONSIBILITY MATRIX

BAS RESPONSIBILITY MATRIX				
WORK	FURNISH	INSTALL	Low Volt. WIRING/TUBE	LINE POWER
BAS low voltage and communication wiring	BAS	BAS	BAS	N/A
VAV box nodes	BAS	23	BAS	26
BAS conduits and raceway	BAS	BAS	BAS	BAS
Automatic dampers	BAS	23	N/A	N/A
Manual valves	22/23	22/23	N/A	N/A
Automatic valves	BAS	22/23	BAS	N/A
VAV boxes	23	23	N/A	N/A
Pipe insertion devices and taps including thermowells, flow and pressure stations.	BAS	22/23	BAS	BAS
BAS Current Switches.	BAS	BAS	BAS	N/A
BAS Control Relays	BAS	BAS	BAS	N/A
Power distribution system monitoring interfaces	26	26	BAS	26
All BAS Nodes, equipment, housings, enclosures and panels.	BAS	BAS	BAS	BAS
Smoke Detectors	28	28	26	26
Fire/Smoke Dampers	23	23	BAS	26
Fire Dampers	23	23	N/A	N/A
VFDs	23	26	BAS	26
Starters, HOA switches	25	26	N/A	26
Control damper actuators	BAS	BAS	BAS	26

**1.6 Submittals - at a minimum, submit the following:**

- A. BAS network architecture diagrams including all nodes and interconnections.
- B. Systems schematics, sequences, flow diagrams, and network layout (BAS MS/TP and IP) on CAD floorplans.
- C. Points schedule for each point in the BAS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
- D. Samples of Graphic Display screen types and associated menus.
- E. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
- F. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
- G. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
- H. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
- I. Details of all BAS interfaces and connections to the work of other trades.
- J. Product data sheets or marked catalog pages including part number, photo and description for all products including software.
- K. Changes made within the current revision of the submittal set shall be clouded or otherwise noted so the modifications are clear.
- L. Layout showing locations of NAEs.
- M. Details of spare capacity.

**1.7 Record Documentation**

- A. Operation and Maintenance Manuals -Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BAS provided:
  - 1. Table of contents.
  - 2. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
  - 3. Manufacturers product data sheets or catalog pages for all products including software.
  - 4. System Operator's manuals.
  - 5. Archive copy of all site-specific databases and sequences.

6. BAS network diagrams.
7. Interfaces to all third-party products and work by other trades.
8. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets.

## **Part 2 - Products**

### **2.1 General Description**

- A. The Building Management System (BAS) shall use an open architecture. To accomplish this effectively, the BAS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
- B. The Building Management System shall consist of the following:
  1. Standalone Network Automation Engine(s)
  2. Field Equipment Controller(s)
  3. Input/Output Module(s)
  4. Local Display Device(s)
  5. Distributed User Interface(s)
- C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
- E. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
- F. The System shall maintain all settings and overrides through a system reboot.
- G. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
- H. The System shall comply with (UL) 864 (UUKL) Ninth Edition Smoke Control Listing including the UL 864 Ninth Edition Standard for Control Units and Accessories for Fire Alarm Systems.
  1. The System shall comply with the following NFPA Codes and Standards as applicable:
  2. NFPA 70 National Electrical Code
  3. NFPA 72 National Fire Alarm Code
  4. NFPA 101 Life Safety Code
  5. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilation Systems

6. NFPA 92B Guide for Smoke Management Systems in Malls, Atria, and Large Areas
7. The System shall comply with the following International Code Council (ICC) Codes:
8. Building Officials and code Administrators International (BOMA) model code
9. International Conference of Building Officials (ICBO) model code
10. Southern Building Code Congress International (SBCCI) regulations
11. Metasys System UL864 UUKL Ninth Edition Smoke Control System Technical Bulletin (LIT-12011252).

I. Acceptable Manufacturers: Johnson Controls, Metasys Extended Architecture

## **2.2 BAS Architecture**

### **A. Automation Network**

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
2. The BAS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Provide application and data server(s) as required for systems operation.
3. All BAS devices on the automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
4. Network Automation Engines (NAE) shall reside on the automation network.

### **B. Control Network**

1. Network Automation Engines (NAE) shall provide supervisory control over the control network and shall support all three (3) of the following communication protocols:
  - a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9. The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label. The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
  - b. LonWorks enabled devices using the Free Topology Transceiver (FTT-10a).
  - c. The Johnson Controls N2 Field Bus.
2. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
5. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.

6. The PICS shall be submitted 10 days prior to bidding.

### 2.3 Integration

- A. Hardwired: Analog and digital signal values shall be passed from one system to another via hardwired connections.
- B. There will be one separate physical point on each system for each point to be integrated between the systems.
- C. Direct Protocol (Integrator Panel): The BAS system shall include appropriate hardware equipment and software to allow bi-directional data communications between the BAS system and 3<sup>rd</sup> party manufacturers' control panels. The BAS shall receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system, and medical gas.
- D. All data required by the application shall be mapped into the Automation Engine's database, and shall be transparent to the operator.
- E. Point inputs and outputs from the third-party controllers shall have real-time interoperability with BAS software features such as: Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and Local Area Network Communications.
- F. BACnet Protocol Integration - BACnet: The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2003.
- G. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.

### 2.4. Site Management User Interface Application Components

- A. Operator Interface: An integrated browser based client application shall be used as the user operator interface program.
- B. The System shall employ an event-driven rather than a device polling methodology to dynamically capture and present new data to the user.
- C. All Inputs, Outputs, Setpoints, and all other parameters shall be displayed for operator viewing and modification from the operator interface software.
- D. The user interface software shall provide help menus and instructions for each operation and/or application.
- E. The system shall support customization of the UI configuration and a home page display for each operator.
- F. The system shall support user preferences in the following screen presentations:
  - 1. Alarm
  - 2. Trend
  - 3. Display
  - 4. Applications
- G. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints,

alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.

- H. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
1. User access for selective information retrieval and control command execution
  2. Monitoring and reporting
  3. Alarm, non-normal, and return to normal condition annunciation
  4. Selective operator override and other control actions
  5. Information archiving, manipulation, formatting, display and reporting
  6. BAS internal performance supervision and diagnostics
  7. On-line access to user HELP menus
  8. On-line access to current BAS as-built records and documentation
  9. Means for the controlled re-programming, re-configuration of BAS operation and for the manipulation of BAS database information in compliance with the prevailing codes, approvals and regulations for individual BAS applications

#### **2.5. Network Automation Engines (NAE)**

A. Network Automation Engine (NAE 55XX)

1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
2. Automation network - The NAE shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface - Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
4. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
5. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
6. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
7. Processor - The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

8. Memory - Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
9. Hardware Real Time Clock - The NAE shall include an integrated, hardware-based, real-time clock.
10. The NAE shall include troubleshooting LED indicators to identify the following conditions:
  - a. Power - On/Off
  - b. Ethernet Traffic - Ethernet Traffic/No Ethernet Traffic
  - c. Ethernet Connection Speed - 10 Mbps/100 Mbps
  - d. FC Bus A - Normal Communications/No Field Communications
  - e. FC Bus B - Normal Communications/No Field Communications
  - f. Peer Communication - Data Traffic between NAE Devices
  - g. Run - NAE Running/NAE in Startup/NAE Shutting Down/Software Not Running
  - h. Bat Fault - Battery Defective, Data Protection Battery Not Installed
  - i. 24 VAC - 24 VAC Present/Loss Of 24VAC
  - j. Fault - General Fault
  - k. Modem RX - NAE Modem Receiving Data
  - l. Modem TX - NAE Modem Transmitting Data
  - m. Communications Ports - The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.
    - n. Two (2) USB port
    - o. Two (2) URS-232 serial data communication port
    - p. Two (2) RS-485 port
    - q. One (1) Ethernet port
11. Diagnostics - The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
12. Power Failure - In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
13. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
14. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.



15. Certification - The NAE shall be listed by Underwriters Laboratories (UL).
16. Controller network - The NAE shall support the following communication protocols on the controller network:
  - a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
  - b. The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
  - c. The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
  - d. A BACnet Protocol Implementation Conformance Statement shall be provided for the NAE.
  - e. The Conformance Statements shall be submitted 10 days prior to bidding.
  - f. The NAE shall support a minimum of 100 control devices.
  - g. The NAE shall support LonWorks enabled devices using the Free Topology Transceiver FTT10.
  - h. All LonWorks controls devices shall be LonMark certified.
  - i. The NAE shall support a minimum of 255 LonWorks enabled control devices.
  - j. The NAE shall support the Johnson Controls N2 Field Bus.
  - k. The NAE shall support a minimum of 100 N2 control devices.
  - l. The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.
  - m. The Bus shall employ a master/slave protocol where the NAE is the master.
  - n. The Bus shall employ a four (4) level priority system for polling frequency.
  - o. The Bus shall be optically isolated from the NAE.
  - p. The Bus shall support the Metasys Integrator System.

B. Network Integration Engine (NIE 55XX)

1. The Network Integration Engine (NIE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers on the N1 Network, provide global strategy and direction, and communicate on a peer-to-peer basis with other NAE and NIE controllers.
2. Automation network - The NIE shall reside on the automation network.
3. Metasys N1 Network Integration - The NIE shall connect Metasys N1 based building automation systems to an Internet Protocol (IP) Ethernet network. The Network Integration Engine shall communicate over the automation network on a peer-to-peer basis with NAE and NIE controllers.

4. The NIE shall monitor and control one or more NCM controllers and transfer point data to provide the following features:
  - a. Alarming and alarm limit management
  - b. Point history and Trend data collection
  - c. Totalization of events, run time, and analog rate value
  - d. Event management and Scheduling
  - e. Energy management
  - f. Data sharing
5. In a manner consistent with the Network Automation Engines, the NIE shall record the following user actions on the Metasys N1 network and include them in an audit log.
  - a. Logging on and off
  - b. Commands to equipment
  - c. Parameter changes
  - d. Changes to the system configuration
6. The following capabilities defined in the Metasys N1 network shall remain fully operational until deleted at the M5 Workstation/OWS.
  - a. Totalization
  - b. Scheduling
  - c. Trend collection capabilities
  - d. Event messaging
  - e. Interlocking
  - f. Control Processes
  - g. Optimal Start
7. The NIE shall monitor and control one or more Network Control Modules (NCM) and transfer point data to provide the following features:
  - a. Alarming and alarm limit management
  - b. Point history and Trend data collection
  - c. Totalization of events, run time, and analog rate value
  - d. Event management and Scheduling
  - e. Energy management
  - f. Data sharing
8. In a manner consistent with the NAE, the NIE shall record the following user actions on the Metasys N1 network and include them in an audit log.
  - a. Logging on and off
  - b. Commands to equipment
  - c. Parameter changes

- d. Changes to the system configuration
- 9. The following capabilities defined in the Metasys N1 network shall remain fully operational until deleted at the M5 Workstation/OWS.
  - a. Totalization
  - b. Scheduling
  - c. Trend collection capabilities
  - d. Event messaging
  - e. Interlocking
  - f. Control Processes
  - g. Optimal Start
- 10. User Interface - Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
- 11. The web based UI software shall be imbedded in the NIE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
- 12. The NIE shall support a minimum of two (2) concurrent users.
- 13. The web based user shall have the capability to access all system data through one NIE.
- 14. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NIE.
- 15. Systems that require the user to address more than one NIE to access all system information are not acceptable.
- 16. The NIE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NIE.
- 17. Systems that support UI Graphics from a central data base or require the graphics to reside on the user's personal computer are not acceptable.
- 18. The NIE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
- 19. Processor - The NIE shall be microprocessor-based with a minimum word size of 32 bits. The NIE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NIE size and capability shall be sufficient to fully meet the requirements of this Specification.
- 20. Memory - Each NIE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
- 21. Hardware Real Time Clock - The NIE shall include an integrated, hardware-based, real-time clock.

22. The NIE shall include troubleshooting LED indicators to identify the following conditions:
  - a. Power - On/Off
  - b. Ethernet Traffic - Ethernet Traffic/No Ethernet Traffic
  - c. Ethernet Connection Speed - 10 Mbps/100 Mbps
  - d. FC Bus A - Normal Communications/No Field Communications
  - e. FC Bus B - Normal Communications/No Field Communications
  - g. Peer Communication - Data Traffic between Automation Network Devices
  - h. Run - NIE Running/NIE in Startup/NIE Shutting Down/Software Not Running
  - i. Bat Fault - Battery Defective, Data Protection Battery Not Installed
  - j. 24 VAC - 24 VAC Present/Loss Of 24VAC
  - k. Fault - General Fault
  - l. Modem RX - NIE Modem Receiving Data
  - m. Modem TX - NIE Modem Transmitting Data
23. Communications Ports - The NIE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.
  - a. Two (2) USB port
  - b. Two (2) URS-232 serial data communication port
  - c. One (1) Ethernet port
24. Diagnostics - The NIE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The NIE shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
25. Power Failure - In the event of the loss of normal power, The NIE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
  - a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
  - b. Upon restoration of normal power and after a minimum off-time delay, the NIE shall automatically resume full operation without manual intervention through a normal soft-start sequence.
26. Certification - The NIE shall be listed by Underwriters Laboratories (UL).

## **2.6 DDC System Controllers**

- A. Field Equipment Controller (FEC X610)

1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
2. The FEC shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
3. The FEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
4. The FEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
5. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
6. The Conformance Statement shall be submitted 10 days prior to bidding.
7. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
8. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
9. The FEC shall include troubleshooting LED indicators to identify the following conditions:
  - a. Power On
  - b. Power Off
  - c. Download or Startup in progress, not ready for normal operation
  - d. No Faults
  - e. Device Fault
  - f. Field Controller Bus - Normal Data Transmission
  - g. Field Controller Bus - No Data Transmission
  - h. Field Controller Bus - No Communication
  - i. Sensor-Actuator Bus - Normal Data Transmission
  - j. Sensor-Actuator Bus - No Data Transmission
  - k. Sensor-Actuator Bus - No Communication
10. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
11. The FEC shall support the following types of inputs and outputs:
12. Universal Inputs - shall be configured to monitor any of the following:
  - a. Analog Input, Voltage Mode
  - b. Analog Input, Current Mode

- c. Analog Input, Resistive Mode
  - d. Binary Input, Dry Contact Maintained Mode
  - e. Binary Input, Pulse Counter Mode
  - f. Binary Inputs - shall be configured to monitor either of the following: Dry Contact Maintained Mode or Pulse Counter Mode
  - g. Analog Outputs - shall be configured to output either of the following: Analog Output, Voltage Mode or Analog Output, current Mode
  - h. Binary Outputs - shall output the following: 24 VAC Triac
  - i. Configurable Outputs - shall be capable of the following: Analog Output, Voltage Mode, Binary Output Mode
13. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
- a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
  - b. The FC Bus shall support communications between the FECs and the NAE.
  - c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.
  - d. The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.
  - e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.
14. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
- a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
  - b. The SA Bus shall support a minimum of 10 devices per trunk.
  - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.
15. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.

## **2.7 Field Devices**

### **A. Input/Output Module (IOM X710)**

- 1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
- 2. The IOM shall communicate with the FEC over the FC Bus or the SA Bus.
- 3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
- 4. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

5. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
  6. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
  7. The Conformance Statement shall be submitted 10 days prior to bidding.
  8. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
  9. The IOM shall have a minimum of 4 points to a maximum of 17 points.
  10. The IOM shall support the following types of inputs and outputs:
  11. Universal Inputs - shall be configured to monitor any of the following:
    - a. Analog Input, Voltage Mode
    - b. Analog Input, Current Mode
    - c. Analog Input, Resistive Mode
    - d. Binary Input, Dry Contact Maintained Mode
    - e. Binary Input, Pulse Counter Mode
  12. Binary Inputs - shall be configured to monitor either of the following:  
Dry Contact Maintained Mode or Pulse Counter Mode
  13. Analog Outputs - shall be configured to output either of the following:  
Analog Output, Voltage Mode or Analog Output, current Mode
  14. Binary Outputs - shall output the following: 24 VAC Triac
  15. Configurable Outputs - shall be capable of the following: Analog Output, Voltage Mode or Binary Output Mode
  16. The IOM shall include troubleshooting LED indicators to identify the following conditions:
    - a. Power On
    - b. Power Off
    - c. Download or Startup in progress, not ready for normal operation
    - d. No Faults
    - e. Device Fault
    - f. Normal Data Transmission
    - g. No Data Transmission
    - h. No Communication
- B. VAV Modular Assembly (VMA 16X0)
1. The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.
  2. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

3. The VMA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
4. A BACnet Protocol Implementation Conformance Statement shall be provided for the VMA.
5. The Conformance Statement shall be submitted 10 days prior to bidding.
6. The VAV Modular Assembly shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.
7. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
8. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.
9. The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
10. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
11. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.
12. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
13. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
14. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
15. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
16. Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
17. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
18. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.



19. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
20. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.
  - a. Absolute temperature loop error
  - b. Signed temperature loop error
  - c. Absolute airflow loop error
  - d. Signed airflow loop error
  - e. Average damper actuator duty cycle
  - f. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:
    - (1) Unreliable space temperature sensor
    - (2) Unreliable differential pressure sensor
    - (3) Starved box
    - (4) Actuator stall
    - (5) Insufficient cooling
    - (6) Insufficient heating
21. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.
22. The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow Based on the percent of outdoor air in the primary air stream.
23. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.
24. Inputs: Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
  - a. 0-10 VDC Sensors
  - b. 1000ohm RTDs
  - c. NTC Thermistors

- d. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
  - e. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
  - f. Provide side loop application for humidity control.
25. Outputs - Analog outputs shall provide the following control outputs:  
0-10 VDC
- a. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
  - b. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.
26. Application Configuration: The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.
27. Sensor Support
- a. The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
  - b. The VMA shall support an LCD display room sensor.
  - c. The VMA shall also support standard room sensors as defined by analog input requirements.
  - d. The VMA shall support humidity sensors defined by the AI side loop.

#### **2.8. Network Sensors (NS-XXX-700X)**

- A. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
  - 1. Zone Temperature
  - 2. Zone Humidity
  - 3. Zone Setpoint
  - 4. Discharge Air Temperature
  - 5. Zone CO2
- B. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
- C. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
  - 1. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
  - 2. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.
  - 3. The Conformance Statement shall be submitted 10 days prior to bidding.
- D. The Network Zone Temperature Sensors shall include the following items:
  - 1. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint
  - 2. An LED to indicate the status of the Override feature

3. A button to toggle the temperature display between Fahrenheit and Celsius
  4. A button to initiate a timed override command
  5. Available in either surface mount or wall mount
  6. Available with either screw terminals or phone jack
- E. The Network Discharge Air Sensors shall include the following:
1. 4 inch or 8 inch duct insertion probe
  2. 10 foot pigtail lead
  3. Dip Switches for programmable address selection
  4. Ability to provide an averaging temperature from multiple locations
  5. Ability to provide a selectable temperature from multiple locations
- F. The Network CO2 Zone Sensors shall include the following:
1. Available in either surface mount or wall mount
  2. Available with screw terminals or phone jack

## 2.9 Input Devices

- A. General Requirements: Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.
- B. Temperature Sensors - General Requirements:
1. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
  2. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
  3. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	$\pm .5^{\circ}\text{F.}$
Room Temp	$\pm .5^{\circ}\text{F.}$
Duct Temperature	$\pm .5^{\circ}\text{F.}$
All Others	$\pm .75^{\circ}\text{F.}$

4. Room Temperature Sensors
  - a. Room sensors shall be constructed for either surface or wall box mounting.
  - b. Room sensors shall have the following options when specified:
  - c. Setpoint reset slide switch providing a  $\pm 3$  degree (adjustable) range.

- d. Individual heating/cooling setpoint slide switches.
  - e. A momentary override request push button for activation of after-hours operation.
  - f. Analog thermometer.
5. Room Temperature Sensors with Integral Display
- a. Room sensors shall be constructed for either surface or wall box mounting.
  - b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
    - (1) Display room and outside air temperatures.
    - (2) Display and adjust room comfort setpoint.
    - (3) Display and adjust fan operation status.
    - (4) Timed override request push button with LED status for activation of after-hours operation.
    - (5) Display controller mode.
    - (6) Password selectable adjustment of setpoint and override modes.
  - c. Thermo wells
    - (1) When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
    - (2) Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
    - (3) Thermo wells and sensors shall be mounted in a threadolet or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
    - (4) Thermo wells shall be constructed of 316 stainless steel.
6. Outside Air Sensors
- a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
  - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
  - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
7. Duct Mount Sensors
- a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
  - b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.

- c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

8. Averaging Sensors

- a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
- b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
- c. Capillary supports at the sides of the duct shall be provided to support the sensing string.
- d. Acceptable Manufacturers: Johnson Controls, Setra.

9. Humidity Sensors

- a. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
- b. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
- c. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
- d. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
- e. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
- f. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
- g. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac.

10. Differential Pressure Transmitters

- a. General Air and Water Pressure Transmitter Requirements:
  - (1) Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
  - (2) Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
  - (3) Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing

pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.

- (4) A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
- (5) Low Differential Water Pressure Applications (0" - 20" w.c.)
- (6) The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
- (7) The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
  - (a) .01-20" w.c. input differential pressure range.
  - (b) 4-20 mA output.
  - (c) Maintain accuracy up to 20 to 1 ratio turndown.
  - (d) Reference Accuracy: +0.2% of full span.
- (8) Acceptable Manufacturers: Setra and Mamac.
- b. Medium to High Differential Water Pressure Applications (Over 21" w.c.)
  - (1) The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
  - (2) Differential pressure range 10" w.c. to 300 PSI.
  - (3) Reference Accuracy: +1% of full span (includes non-linearity, hysteresis, and repeatability).
  - (4) Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
  - (5) Acceptable Manufacturers: Setra and Mamac.
- c. Building Differential Air Pressure Applications (-1" to +1" w.c.)
  - (1) The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
  - (2) The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
    - (a) -1.00 to +1.00 w.c. input differential pressure ranges.  
(Select range appropriate for system application)
    - (b) 4-20 mA output.
    - (c) Maintain accuracy up to 20 to 1 ratio turndown.

- (d) Reference Accuracy: +0.2% of full span.
- (3) Acceptable Manufacturers: Johnson Controls and Setra.
- d. Low Differential Air Pressure Applications (0" to 5" w.c.)
  - (1) The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
  - (2) The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
    - (a) (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
    - (b) 4-20 mA output.
    - (c) Maintain accuracy up to 20 to 1 ratio turndown.
    - (d) Reference Accuracy: +0.2% of full span.
  - (3) Acceptable Manufacturers: Johnson Controls and Setra.
- e. Medium Differential Air Pressure Applications (5" to 21" w.c.)
  - (1) The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
    - (a) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
    - (b) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG).
    - (c) Thermal Effects: <+.033 F.S./Deg F. over 40F. to 100F. (calibrated at 70F.).
  - (2) Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
  - (3) Acceptable manufacturers: Johnson Controls and Setra.

#### C. Flow Monitoring

##### 1. Air Flow Monitoring

###### a. Fan Inlet Air Flow Measuring Stations

- (1) At the inlet of each fan and near the exit of the inlet sound trap, airflow traverse probes shall be provided that shall continuously monitor the fan air volumes and system velocity pressure.
- (2) Each traverse probe shall be of a dual manifolded, cylindrical, type 3003 extruded aluminum configuration, having an anodized finish to eliminate surface pitting and unnecessary air friction. The multiple total pressure manifold shall have sensors located

along the stagnation plane of the approaching airflow. The manifold should not have forward projecting sensors into the air stream. The static pressure manifold shall incorporate dual offset static tops on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as  $\pm 20^\circ$  in the approaching air stream.

- (3) The airflow traverse probe shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Each airflow-measuring probe shall contain multiple total and static pressure sensors placed at equal distances along the probe length. The number of sensors on each probe and the quantity of probes utilized at each installation shall comply with the ASHRAE Standards for duct traversing.
  - (4) Airflow measuring stations shall be manufactured by Air Monitor Corp., Tek-Air Systems, Inc., Ebtron, or Dietrich Standard.
- b. Single Probe Air Flow Measuring Sensor: The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a hot wire anemometer and utilize two temperature sensors and a heater element temperature. The other sensor shall measure the downstream air temperature. The temperature differential shall be directly related to airflow velocity.
- c. Duct Air Flow Measuring Stations
- (1) Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.
  - (2) Airflow measuring stations shall be fabricated of 14-gauge galvanized steel welded casing with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4" maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 6000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area, equalize the velocity profile, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.
  - (3) The total pressure measurement side (high side) will be designed and spaced to the Industrial Ventilation Manual 16th Edition, Page 9-5. The self-averaging manifolding will be manufactured of brass and copper components.
  - (4) The static pressure sensing probes (low side) shall be bullet-nosed shaped, per detailed radius, as illustrated in Industrial Ventilation Manual 16th Edition, Page 9-5.
  - (5) The main take-off point from both the total pressure and the static pressure manifolds must be symmetrical.



- (6) Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.

d. Installation Considerations

- (1) *The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .065" w.c. at 1000 feet per minute, or .23" w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 2% as determined by U.S. - GSA certification tests, and shall contain a minimum of one total pressure sensor per 36 square inches of unit measuring area.*
- (2) *The units shall have a self-generated sound rating of less than NC40, and the sound level within the duct shall not be amplified nor shall additional sound be generated.*
- (3) *Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.*
- (4) *Where control dampers are shown as part of the airflow measuring station, opposed blade precision controlled volume dampers integral to the station and complete with actuator, pilot positioner, and linkage shall be provided.*
- (5) *Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.*
- (6) Acceptable manufacturers: Air Monitor Corp., Tek-Air, Ebtron, and Dietrich Standard.

e. Static Pressure Traverse Probe

- (1) Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.
- (2) Acceptable manufacturers: Cleveland Controls

f. Shielded Static Air Probe: A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.

2. Water Flow Monitoring

- a. Water flow meters shall be electromagnetic type with integral microprocessor-Based electronics. The meter shall have an accuracy of 0.25%.
- b. Acceptable manufacturers: Onicon

D. Power Monitoring Devices

1. Current Measurement (Amps)

- a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
  - b. Current Transformer - A split core current transformer shall be provided to monitor motor amps.
    - (1) Operating frequency - 50 - 400 Hz.
    - (2) Insulation - 0.6 Kv class 10Kv BIL.
    - (3) UL recognized.
    - (4) Five amp secondary.
    - (5) Select current ration as appropriate for application.
    - (6) Acceptable manufacturers: Veris Industries
  - c. Current Transducer - A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
    - (1) 6X input over amp rating for AC inrushes of up to 120 amps.
    - (2) Manufactured to UL 1244.
    - (3) Accuracy: +.5%, Ripple +1%.
    - (4) Minimum load resistance 30kOhm.
    - (5) Input 0-20 Amps.
    - (6) Output 4-20 mA.
    - (7) Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
    - (8) Acceptable manufacturers: Veris Industries
- F. Smoke Detectors: Ionization type air duct detectors shall be furnished as specified elsewhere in Division 16 for installation under Division 15. All wiring for air duct detectors shall be provided under Division 16, Fire Alarm System.

## **2.12 Status and Safety Switches**

- A. General Requirements: Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
- B. Current Sensing Switches
  - 1. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.

2. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
3. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
4. Acceptable manufacturers: Veris Industries

C. Air Filter Status Switches

1. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
2. A complete installation kit shall be provided, including: static pressure taps, tubing, fittings, and air filters.
3. Provide appropriate scale range and differential adjustment for intended service.
4. Acceptable manufacturers: Johnson Controls, Cleveland Controls

D. Air Flow Switches

1. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
2. Acceptable manufacturers: Johnson Controls, Cleveland Controls

E. Air Pressure Safety Switches

1. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
2. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
3. Acceptable manufacturers: Johnson Controls, Cleveland Controls

F. Water Flow Switches: Water flow switches shall be equal to the Johnson Controls P74.

G. Low Temperature Limit Switches

1. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
2. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
3. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
4. The low temperature limit switch shall be equal to Johnson Controls A70.

## 2.13 Output Devices

A. Actuators

1. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.
2. Electronic Damper Actuators
  - a. Electronic damper actuators shall be direct shaft mount.
  - b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
  - c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
  - d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
  - e. Acceptable manufacturers: Johnson Controls, Mamac.
3. Electronic Valve Actuators
  - a. Electronic valve actuators shall be manufactured by the valve manufacturer.
  - b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
  - c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

- d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
- e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.
- f. Acceptable manufacturers: Johnson Controls

#### B. Control Dampers

- 1. The BAS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BAS Contractor or as specifically indicated on the Drawings.
- 2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
- 3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
- 4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
- 5. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g. Acceptable manufacturers are Johnson Controls D-7250 D-1250 or D-1300, Ruskin CD50, and Vent Products 5650.
- 6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Johnson Controls D-1600, Ruskin CD36, and Vent Products 5800.
- 7. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

#### C. Control Relays

1. Control Pilot Relays

- a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
- b. Mounting Bases shall be snap-mount.
- c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
- d. Contacts shall be rated for 10 amps at 120VAC.
- e. Relays shall have an integral indicator light and check button.
- f. Acceptable manufacturers: Johnson Controls, Lectro

2. Lighting Control Relays

- a. Lighting control relays shall be latching with integral status contacts.
- b. Contacts shall be rated for 20 amps at 277 VAC.
- c. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
- d. Lighting control relays shall be controlled by:
  - (1) Pulsed Tri-state Output - Preferred method.
  - (2) Pulsed Paired Binary Outputs.
  - (3) A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the "dry-contact" type.
- e. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

D. Control Valves

- 1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.
- 2. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop,

but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.

3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter. The JCI VG1000 series ball valves are the standard valve for terminal units. They shall have a threaded connection, stainless steel trim, and 24VAC, 0-10VDC signal, fail last position, electric actuators.
4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.
5. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.
6. Acceptable manufacturers: Johnson Controls

E. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BAS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.
4. Acceptable manufacturers: Advanced Control Technologies

F. External Manual Override Stations

1. External manual override stations shall provide the following:
2. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.
3. A status input to the Facility Management System shall indicate whenever the switch is not in the automatic position.
4. A Status LED shall illuminate whenever the output is ON.
5. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.
6. Contacts shall be rated for a minimum of 1 amp at 24 VAC.

G. Electronic/Pneumatic Transducers

1. Electronic to Pneumatic transducers shall provide:
2. Output: 3-15 PSIG.
3. Input: 4-20 mA or 0-10 VDC.
4. Manual output adjustment.
5. Pressure gauge.
6. External replaceable supply air filter.
7. Acceptable manufacturers: Johnson Controls, Mamac

## **2.14 Miscellaneous Devices**

### **A. Local Control Panels**

1. All control panels shall be factory constructed, incorporating the BAS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

### **B. Power Supplies**

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.



- C. Thermostats: Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

### **Part 3 - Performance / Execution**

#### **3.1 BAS Specific Requirements**

##### **A. Graphic Displays**

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

##### **B. Custom Reports - Provide custom reports as required for this project:**

##### **C. Actuation / Control Type**

###### **1. Primary Equipment**

- a. Controls shall be provided by equipment manufacturer as specified herein.
- b. All damper and valve actuation shall be electric.

###### **2. Air Handling Equipment**

- a. All air handlers shall be controlled with a HVAC-DDC Controller
- b. All damper and valve actuation shall be electric.

###### **3. Terminal Equipment:**

- a. Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation. The JCI VG1000 series ball valve is the standard valve for terminal units. They shall have a threaded connection, stainless steel trim, 24VAC, 0-10VDC signal, fail last position, electric actuators.
- b. All Terminal Units shall be controlled with HVAC-DDC Controller). Terminal units shall generally have controller: MS-VMA1620-OU, zone temperature sensor, valve (when applicable), and discharge air temperature sensor. The VMA controller shall be configured for use of a DIS plug-in displacer. The points the controller's application file shall be configured for include: zone temp, effective heating setpoint, effective cooling setpoint, nominal setpoint, effective occupancy mode, discharge air temp, valve position, damper position, supply CFM, supply CFM setpoint, k-factor, supply area, cooling min flow, heating minimum flow, cooling max flow.

##### **D. Installation Practices**

###### **1. BAS Wiring**

- a. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BAS Contractor unless specifically

shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.

- b. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
- c. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.

## 2. Class 2 Wiring

- a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
- b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
- c. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
- d. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

## 3. BAS Line Voltage Power Source

- a. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.
- b. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
- c. DDC terminal unit controllers may use AC power from motor power circuits.

## 4. BAS Raceway

- a. All wiring shall be installed in conduit or raceway. The only exception is wiring from zone temperature sensor through the wall and above a suspended ceiling for a VAV box terminal unit. When wiring reaches the bottom of the interstitial space (top of the suspended ceiling), the penetration through the barrier and all wiring in the interstitial shall be in raceway. Minimum control wiring conduit size 1/2".
- b. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.

- c. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
  - d. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
  - e. All raceway for BAS shall be green. Junction boxes for BAS wiring shall have covers that are painted green.
5. Penetrations
- a. Provide fire stopping for all penetrations used by dedicated BAS conduits and raceways.
  - b. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
  - c. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
  - d. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
6. BAS Identification Standards
- a. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
  - b. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.
7. BAS Panel Installation
- a. The BAS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
  - b. The BAS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.
8. Input Devices
- a. All Input devices shall be installed per the manufacturer recommendation. Standard analog sensors shall be 1K ohm nickel with 0-10VDC output control for devices.
  - b. Locate components of the BAS in accessible local control panels wherever possible.
9. HVAC Input Devices - General
- a. All Input devices shall be installed per the manufacturer recommendation.
  - b. Locate components of the BAS in accessible local control panels wherever possible.

- c. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
- d. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.

10. Outside Air Sensors

- a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
- b. Sensors shall be installed with a rain proof, perforated cover.

11. Water Differential Pressure Sensors

- a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
- b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
- c. The transmitters shall be installed in an accessible location wherever possible.
- d. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
- e. Air bleed units, bypass valves and compression fittings shall be provided.
- f. Building Differential Air Pressure Applications (-1" to +1" w.c.):
- g. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
- h. The interior tip shall be inconspicuous and located as shown on the drawings.

12. Air Flow Measuring Stations:

- a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
- b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.

13. Duct Temperature Sensors:

- a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
- b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
- c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
- d. The sensor shall be mounted to suitable supports using factory approved element holders.

14. Space Sensors:
  - a. Public space: blank face SA bus NS series net-stat, addressable: NS-BTN7003-0. If humidity or CO2 sensing is needed, refer to JCI for recommendation.
  - b. Interior Zones (spaces other than public corridors or open areas): SA bus NS series net-stat with display, setpoint adjust, terminal block, addressable: NS-BTB7003-0.
  - c. Shall be mounted per ADA requirements.
  - d. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
15. Low Temperature Limit Switches:
  - a. Install on the discharge side of the first water or steam coil in the air stream.
  - b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
  - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
16. Air Differential Pressure Status Switches: Install with static pressure tips, tubing, fittings, and air filter.
17. Water Differential Pressure Status Switches: Install with shut off valves for isolation.
18. HVAC Output Devices
  - a. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
  - b. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
  - c. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
  - d. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
  - e. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall

provide ground plane isolation between systems. Signals shall provide optical isolation between systems

**3.2 Training** - The BAS contractor shall provide the following training services: One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BAS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

### **3.3 Commissioning**

A. Provide support to fully commission all aspects of the Building Management System work and related MEP systems.

B. Acceptance Check Sheet

1. Prepare a check sheet that includes all points for all functions of the BAS as indicated on the point list included in this specification.
2. Submit the check sheet to the Engineer for approval
3. The Engineer will use the check sheet as the basis for acceptance with the BAS Contractor.

C. VAV box (and Venturi Valve) performance verification and documentation:

1. The BAS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
2. The BAS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance.

D. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

### **3.4 Naming Conventions**

A. NxE Device Naming/Configuration: NxEBB-AF-X

1. Replace BB with building number (two digits).
2. Replace A with geographical area of building that the NAE resides in.
3. Replace F with floor that the NAE resides on.
4. Replace X with NAE number.

B. Communication Bus Naming/Configuration: FC-1 = FC Trunk 1, N2-1 = N2 Trunk 1

C. Controller Naming/Configuration: NxEBB-AF-X (example: 70.VAV-44-001)

1. Replace DD with controller address (two digits).
2. Replace BB with building number.

3. Replace SYSTEM TYPE with type of system, i.e. AHU, HWS, CHWS, HV, UH, etc.
  4. Replace ## with the system equipment tag, i.e. AHU-44, HV-06, etc.
- D. Air Handler Unit Point Naming: BB.AHU-##.POINTNAME (example: 70.AHU-44.OCC-SCHEDULE)
1. Replace BB with building number (two digits).
  2. Replace ## with the system equipment tag, i.e. AHU-44, HV-06, etc.
  3. Replace POINTNAME with description of point.
- E. Variable Air Volume Box (VAV Box) Point Naming: BB.VAV-AA-VVV.POINTNAME (example: 70.VAV-44-001.OCC-SCHEDULE)
1. Replace BB with building number (two digits).
  2. Replace AA with AHU equipment tag.
  3. Replace VVV with VAV tag (always 3 digits).
  4. Replace POINTNAME with description of point.
- F. Chilled or Hot Water System Point Naming: BB.HWS-##.POINTNAME (example: 70.SEC-HWS-44-001.SYSTEM-EN)
1. Replace BB with building number (two digits).
  2. Replace ## with the system equipment tag - example: DOMHX-44.
  3. Replace POINTNAME with description of point.
- G. Critical Monitoring Point Naming: BB-AA.POINTNAME (example: BB-AA.CRITICAL.PASS-ELEV#)
1. Replace BB with building number (two digits).
  2. Replace AA with area number.
  3. Replace POINTNAME with description of point.

### 3.5 Point Lists - Example

Systems AHU 1,2,3,4

Point	Description	Type	Units	Trend	Alarm	Totalize
DA-P	Discharge Static Pressure	AI	in WC	X		
DA-T	Discharge Air Temperature	AI	Deg F	X		
PH-T	Preheat Temperature	AI	Deg F	X		
SF-S	Supply Fan Status	BI	Off On	X	X	X
PH-O	Preheat Output	AO	%	X		
RH-O	Reheat Output	AO	%	X		

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CLG-O	Cooling Output	AO	%	X
SF-O	Supply Fan Output	AO	%	X
SF-C	Supply Fan Command	BO	Off On	X
PH-LCKO	Preheat Lockout Command	BO	Off On	X
CLG-LCKO	Cooling Lockout Command	BO	Off On	X
RH-LCKO	Reheat Lockout Command	BO	Off On	X
DAT-SP	Discharge Temperature Setpoint	AO	Deg F	X
PHT-SP	Preheat Temperature Setpoint	AO	Deg F	X
DAP-SP	Discharge Static Pressure Setpoint	AO	in WC	X



**SECTION 23 21 13**  
**HYDRONIC PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Water piping to connect HVAC equipment, including the following:
  - 1. Chilled water, condenser water, heating hot water and drain piping.
  - 2. Extension of domestic water make-up piping.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION:  
General mechanical requirements and items, which are common to more than one section of Division 23.
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Piping insulation.
- E. Section 23 21 13, HYDRONIC PIPING:
- F. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Temperature and pressure sensors and valve operators.

**1.3 QUALITY ASSURANCE**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, which includes welding qualifications.
- B. Design Working Pressure for Preinsulated Chilled Water Piping: 861 kPa (125 psig).
- C. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.
- D. Manufacturers Training Service: The Contractor shall obtain the services of an independent trained representative of the preinsulated chilled water pipe system manufacturer to instruct contractor's work force in installation procedures for all preinsulated, prefabricated systems.

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Pipe and equipment supports.
  - 2. Pipe and tubing, with specification, class or type, and schedule.
  - 3. Pipe fittings, including miscellaneous adapters and special fittings.
  - 4. Flanges, gaskets and bolting.
  - 5. Valves of all types.
  - 6. Strainers.
  - 7. Flexible connectors for water service.
  - 8. Pipe alignment guides.
  - 9. Expansion joints.
  - 10. Expansion compensators.
  - 11. All specified hydronic system components.
  - 12. Water flow measuring devices.
  - 13. Gages.
  - 14. Thermometers and test wells.
  - 15. Electric heat tracing systems.
- E. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.
- F. Coordination Drawings: Refer to Article, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- G. As-Built Piping Diagrams: Provide drawing as follows for chilled water, condenser water, and heating hot water system and other piping systems and equipment. .
  - 1. One wall-mounted stick file with complete set of prints. Mount stick file in the chiller plant or control room along with control diagram stick file.
  - 2. One complete set of reproducible drawings.
  - 3. One complete set of drawings in electronic format (Autocad, pdf, or other approved format).

### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
- B1.20.1-83.....Pipe Threads, General Purpose (Inch)
  - B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
  - B16.3-98.....Malleable Iron Threaded Fittings
  - B16.4-98.....Gray Iron Threaded Fittings
  - B16.5-03.....Pipe Flanges and Flanged Fittings
  - B16.9-03.....Factory-Made Wrought Buttwelding Fittings
  - B16.11-05.....Forged Fittings, Socket-Welding and Threaded
  - B16.14-91.....Ferrous Pipe Plugs, Bushings, and Locknuts with  
Pipe Threads
  - B16.22-01.....Wrought Copper and Copper Alloy Solder-Joint  
Pressure Fittings
  - B16.23-02.....Cast Copper Alloy Solder Joint Drainage  
Fittings
  - B16.24-01.....Cast Copper Alloy Pipe Flanges and Flanged  
Fittings, Class 150, 300, 400, 600, 900, 1500  
and 2500
  - B16.39-98.....Malleable Iron Threaded Pipe Unions, Classes  
150, 250, and 300
  - B16.42-98.....Ductile Iron Pipe Flanges and Flanged Fittings:  
Classes 150 and 300
  - B31.1-01.....Power Piping
  - B31.9-04.....Building Services Piping
  - B40.100-05.....Pressure Gauges and Gauge Attachments
- C. American National Standards Institute, Inc. (ANSI):
- B16.1 00.....Cast Iron Pipe Flanges and Flanged Fittings,  
Class 25, 125 and 250
  - B16.3 00.....Malleable Iron Threaded Fittings Classes 150  
and 300
  - B16.5 03.....Pipe Flanges and Flanged Fittings NPS ½ through  
NPS 24

- B16.9 03.....Factory Made Wrought Butt Welding Fittings
- B16.11 01.....Forged Fittings, Socket Welding and Threaded
- B16.14 91.....Ferrous Pipe Plugs, Bushings and Locknuts with  
Pipe Threads
- B16.18-01.....Cast Copper Alloy Solder joint Pressure  
fittings
- B16.22 00.....Wrought Copper and Bronze Solder Joint Pressure  
Fittings
- B16.24 01.....Cast Copper Alloy Pipe Fittings and Flanged  
Fittings: Class 150, 300, 400, 600, 900, 1500  
and 2500
- B31.1 01.....Power Piping
- D. American Society for Testing and Materials (ASTM):
- A47/A47M-99 (2004).....Ferritic Malleable Iron Castings
- A53/A53M-06.....Standard Specification for Pipe, Steel, Black  
and Hot-Dipped, Zinc-Coated, Welded and  
Seamless
- A106/A106M-06.....Standard Specification for Seamless Carbon  
Steel Pipe for High-Temperature Service
- A126-04.....Standard Specification for Gray Iron Castings  
for Valves, Flanges, and Pipe Fittings
- A181/A181M-01.....Standard Specification for Carbon Steel  
Forgings, for General-Purpose Piping
- A183-03 ..... Standard Specification for Carbon Steel Track  
Bolts and Nuts
- A216/A216M-04 ..... Standard Specification for Steel Castings,  
Carbon, Suitable for Fusion Welding, for High  
Temperature Service
- A234/A234M 04 ..... Piping Fittings of Wrought Carbon Steel and  
Alloy Steel for Moderate and High Temperature  
Service
- A307-04 ..... Standard Specification for Carbon Steel Bolts  
and Studs, 60,000 PSI Tensile Strength
- A536-84 (2004) ..... Standard Specification for Ductile Iron Castings

A653/A 653M-04 .....	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) By the Hot-Dip Process
B32-04 .....	Standard Specification for Solder Metal
B61-02 .....	Standard Specification for Steam or Valve Bronze Castings
B62-02 .....	Standard Specification for Composition Bronze or Ounce Metal Castings
B88-03 .....	Standard Specification for Seamless Copper Water Tube
B209 04 .....	Aluminum and Aluminum Alloy Sheet and Plate
C177 97 .....	Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus
C478-03 .....	Precast Reinforced Concrete Manhole Sections
C533 03 .....	Calcium Silicate Block and Pipe Thermal Insulation
C552 03 .....	Cellular Glass Thermal Insulation
D2464 99 .....	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
D3139 98 .....	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
F439-06 .....	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
F441/F441M-02 .....	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
F477-02 .....	Elastomeric Seals Gaskets) for Joining Plastic Pipe
E. American Water Works Association (AWWA):	
C110/03.....	Ductile Iron and Grey Iron Fittings for Water
C203 00.....	Coal Tar Protective Coatings and Linings for Steel Water Pipe Lines Enamel and Tape Hot Applied

- F. American Welding Society (AWS):  
A5.8/A5.8M-04.....Specification for Filler Metals for Brazing and  
Braze Welding  
B2.1-02.....Standard Welding Procedure Specification
- G. Copper Development Association, Inc. (CDA):  
CDA A4015-95.....Copper Tube Handbook
- H. Expansion Joint Manufacturer's Association, Inc. (EJMA):  
EMJA-2003.....Expansion Joint Manufacturer's Association  
Standards, Eighth Edition
- I. Manufacturers Standardization Society (MSS) of the Valve and Fitting  
Industry, Inc.:  
SP-67-02a.....Butterfly Valves  
SP-70-06.....Gray Iron Gate Valves, Flanged and Threaded  
Ends  
SP-71-05.....Gray Iron Swing Check Valves, Flanged and  
Threaded Ends  
SP-72-99.....Ball Valves with Flanged or Butt-Welding Ends  
for General Service  
SP-78-05.....Cast Iron Plug Valves, Flanged and Threaded  
Ends  
SP-80-03.....Bronze Gate, Globe, Angle and Check Valves  
SP-85-02.....Cast Iron Globe and Angle Valves, Flanged and  
Threaded Ends
- J. National Sanitation Foundation (NSF):  
14 03.....Plastic Piping System Components and Related  
Materials
- K. Tubular Exchanger Manufacturers Association: TEMA 8th Edition, 2000
- L. Sheet Metal and Air Conditioning Contractors National Association  
(SMACNA):  
HVAC Duct Construction Standards, 2nd Edition 1997

## **PART 2 - PRODUCTS**

### **2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES**

Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR  
HVAC AND STEAM GENERATION.

## **2.2 PIPE AND TUBING**

- A. Pipe supports, including insulation shields, for above ground piping:  
Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

## **2.3 FITTINGS FOR STEEL PIPE**

- A. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Mechanical couplings and fittings are optional for water piping only.
1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
  2. Welding flanges and bolting: ASME B16.5:
    - a. Water service: Weld neck or slip-on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).
      - 1) Contractor's option: Convoluted, cold formed 150 pound steel flanges, with teflon gaskets, may be used for water service.
    - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- B. 50 mm (2 inches) and Smaller: Screwed or welded. Mechanical couplings are optional for water piping only.
1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
  2. Forged steel, socket welding or threaded: ASME B16.11.
  3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
  4. Unions: ASME B16.39.
  5. Water hose connection adapter: Brass, pipe thread to 20 mm (3/4 inch) garden hose thread, with hose cap nut.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.
- D. Mechanical Pipe Couplings and Fittings: May be used, with cut or roll grooved pipe, in water service up to 110 degrees C (230 degrees F) in lieu of welded, screwed or flanged connections.

1. Grooved mechanical couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two or more parts, securely held together by two or more track-head, square, or oval-neck bolts, ASTM A183.
2. Gaskets: Rubber product recommended by the coupling manufacturer for the intended service.
3. Grooved end fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

#### **2.4 FITTINGS FOR COPPER TUBING**

##### **A. Solder Joint:**

1. Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.

##### **B. Bronze Flanges and Flanged Fittings: ASME B16.24.**

#### **2.5 DIELECTRIC FITTINGS**

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 99 degrees C (210 degrees F).

#### **2.6 SCREWED JOINTS**

- A. Pipe Thread: ANSI B1.20.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

#### **2.7 VALVES**

- A. Asbestos packing is not acceptable.



- B. All valves of the same type shall be products of a single manufacturer. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.
- C. Provide chain operators for valves 100 mm (4 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.
- D. Gate Valves:
1. 50 mm (2 inches) and smaller: MSS-SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
  2. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke.
    - a. MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.
- E. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
1. Body: Cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
  2. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.
- F. Butterfly Valves: May be used in lieu of gate valves in water service except for direct buried pipe. Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation.
1. MSS-SP 67, flange lug type (for end of line service) or grooved end rated 150 psig working pressure at 200 degrees F, Walworth, Apollo, or approved equal.
    - a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
    - b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft

or stem is acceptable, if the stem is completely isolated from the product.

- c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
  - 1) Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
  - 2) Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.
- H. Ball Valves: Brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig) working pressure rating. Screwed or solder connections. Provide stem extension to allow operation without interfering with pipe insulation.
- I. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size and be one of the following types.
  - 1. Butterfly valve as specified herein with memory stop.
  - 2. Eccentric plug valve: Iron body, bronze or nickel-plated iron plug, bronze bearings, adjustable memory stop, operating lever, rated 861 kPa (125 psig) and 121 degrees C (250 degrees F).
- J. Circuit Setter Valve: A dual purpose flow balancing valve and adjustable flow meter, with bronze or cast iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.
- K. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:
  - 1. Gray iron (ASTM A126) or brass body rated 1205 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless steel piston and spring.
  - 2. Brass or ferrous body designed for 2067 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper

- proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.
- L. Manual Radiator/Convactor Valves: Brass, packless, with position indicator.

## **2.8 WATER FLOW MEASURING DEVICES**

- A. Minimum overall accuracy plus or minus three percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.
- B. Venturi Type: Bronze, steel, or cast iron with bronze throat, with valved pressure sensing taps upstream and at the throat.
- C. Flow Measurement/Balance Valves: A system comprised of two valves of bronze and stainless steel metallurgy designed for 1205 kPa (175 psig) pressure at 121 degrees C (250 degrees F), with thermal insulation sleeve.
1. Measurement and shut-off valve: An on/off ball valve with integral high regain venturi and dual quick connect valves with integral check valves and color coded safety caps for pressure/temperature readout.
2. A butterfly balancing valve as specified herein, with memory stop and quick connect valve for pressure/temperature readout.
- D. Flow Measuring Device Identification:
1. Metal tag attached by chain to the device.
2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate in l/m (gpm).

## **2.9 STRAINERS**

- A. Basket or Y Type. Tee type is acceptable for water service.
- B. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations.
2. 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.
- C. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

## **2.10 FLEXIBLE CONNECTORS FOR WATER SERVICE**

### **A. Flanged Spool Connector:**

1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
2. Working pressures and temperatures shall be as follows:
  - a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165psig) at 121 degrees C (250 degrees F).
  - b. Connector sizes 125 mm to 300 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).
3. Provide ductile iron retaining rings and control units.

### **B. Mechanical Pipe Couplings:**

See other fittings specified under Part 2, PRODUCTS.

## **2.11 EXPANSION JOINTS**

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.
- C. Expansion Compensators:
  1. Corrugated bellows, externally pressurized, stainless steel or bronze.
  2. Internal guides and anti-torque devices.
  3. Threaded ends.
  4. External shroud.
  5. Conform to standards of EJMA.
- F. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature,

date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.

- I. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

#### **2.12 GAGES, PRESSURE AND COMPOUND**

- A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.
- C. Range of Gages: Provide range equal to at least 130 percent of normal operating range.
1. For condenser water suction (compound): Minus 100 kPa (30 inches Hg) to plus 700 kPa (100 psig).

#### **2.13 PRESSURE/TEMPERATURE TEST PROVISIONS**

- A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.
- B. Provide one each of the following test items to the COR:
1. 6 mm (1/4 inch) FPT by 3 mm (1/8 inch) diameter stainless steel pressure gage adapter probe for extra long test plug. PETE'S 500 XL is an example.
2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gage, , --100 kPa (30 inches) Hg to 700 kPa (100 psig) range.

3. 0 - 104 degrees C (220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (one inch) dial, 125 mm (5 inch) long stainless steel stem, plastic case.

#### **2.14 FIRESTOPPING MATERIAL**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Install convertors and other heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
- D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

- E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- H. Provide manual air vent at all piping system high points and drain valves at all low points.
- I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
  - 1. Water treatment pot feeders and condenser water treatment systems.
  - 2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- J. Thermometer Wells: In pipes 65 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.
- K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- L. Where copper piping is connected to steel piping, provide dielectric connections.

### **3.2 PIPE JOINTS**

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

- B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. Mechanical Joint: Pipe grooving shall be in accordance with joint manufacturer's specifications. Lubricate gasket exterior including lips, pipe ends and housing interiors to prevent pinching the gasket during installation. Lubricant shall be as recommended by coupling manufacturer.
- D. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
- E. Solvent Welded Joints: As recommended by the manufacturer.

### **3.3 LEAK TESTING ABOVEGROUND PIPING**

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COR. Tests may be either of those below, or a combination, as approved by the COR.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

### **3.4 FLUSHING AND CLEANING PIPING SYSTEMS**

- A. Water Piping: Clean systems as recommended by the suppliers of chemicals.
  - 1. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove



- any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the COR.
2. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

### **3.5 OPERATING AND PERFORMANCE TEST AND INSTRUCTION**

- A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Adjust red set hand on pressure gages to normal working pressure.

- - - E N D - - -

**SECTION 23 31 00**  
**HVAC DUCTS AND CASINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Ductwork and accessories for HVAC including the following:
  - 1. Supply air, return air, outside air, exhaust, and relief systems.
- B. Definitions:
  - 1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
  - 2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
  - 3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
  - 4. Exposed Duct: Exposed to view in a finished room, exposed to weather.

**1.2 RELATED WORK**

- A. Fire Stopping Material: Section 07 84 00, FIRESTOPPING.
- B. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- C. Duct Insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION
- D. Plumbing Connections: Section 22 11 00, FACILITY WATER DISTRIBUTION
- E. Air Flow Control Valves and Terminal Units: Section 23 36 00, AIR TERMINAL UNITS.
- F. Duct Mounted Instrumentation: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- G. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

**1.3 QUALITY ASSURANCE**

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Fire Safety Code: Comply with NFPA 90A.
- C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.

- D. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.
- E. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Rectangular ducts:
    - a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
    - b. Duct liner.
    - c. Sealants and gaskets.
    - d. Access doors.
  - 2. Round and flat oval duct construction details:
    - a. Manufacturer's details for duct fittings.
    - b. Duct liner.
    - c. Sealants and gaskets.
    - d. Access sections.
    - e. Installation instructions.
  - 3. Volume dampers, back draft dampers.
  - 4. Upper hanger attachments.
  - 5. Fire dampers, fire doors, and smoke dampers with installation instructions.
  - 6. Sound attenuators, including pressure drop and acoustic performance.
  - 7. Flexible ducts and clamps, with manufacturer's installation instructions.
  - 8. Flexible connections.
  - 9. Instrument test fittings.
  - 10. Details and design analysis of alternate or optional duct systems.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Moving and Conditioning Association (AMCA):  
500D-98.....Laboratory Method of Testing Dampers for Rating  
500L-99.....Laboratory Method of Testing Louvers for Rating
- C. American Society of Civil Engineers (ASCE):  
ASCE7-98.....Minimum Design Loads for Buildings and Other Structures
- D. American Society for Testing and Materials (ASTM):  
A167-99.....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip  
A653-01.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process  
A1011-02.....Standard Specification for Steel Sheet and Strip Hot rolled Carbon structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability  
B209-01.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate  
C1071-00.....Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)  
E84-01.....Standard Test Method for Surface Burning Characteristics of Building Materials
- E. National Fire Protection Association (NFPA):  
90A-99.....Standard for the Installation of Air Conditioning and Ventilating Systems  
96-01.....Ventilation Control and Fire Protection of Commercial Cooking Operations
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):  
2nd Edition - 1995.....HVAC Duct Construction Standards, Metal and Flexible  
1st Edition, 1985.....HVAC Air Duct Leakage Test Manual

6th Edition - 1992.....Fibrous Glass Duct Construction Standards

G. Underwriters Laboratories, Inc. (UL):

33-93.....UL Standard for Safety Heat Responsive Links for  
Fire Protection Service

181-96.....UL Standard for Safety Factory-Made Air Ducts  
and Connectors

555-02 .....Fire Dampers

555S-02 .....Smoke Dampers

## **PART 2 - PRODUCTS**

### **2.1 DUCT MATERIALS AND SEALANTS**

- A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A527, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.
- B. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A167, Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct or ducts located in mechanical rooms.
- D. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, paragraph S1.9.
  - 1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
  - 2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
  - 3. Gaskets in Flanged Joints: Soft neoprene.
- E. Approved factory made joints such as DUCTMATE SYSTEM may be used.

### **2.2 DUCT CONSTRUCTION AND INSTALLATION**

- A. Follow SMACNA HVAC Duct Construction Standards.
- B. Duct Pressure Class: 3 inch W.G.
- C. Seal Class: As shown on the drawings and in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
- D. Operating Room Supply Air: Duct and casing downstream of the after-filter shall be stainless steel. Provide access doors or panels

for duct cleaning at 6 m (20 feet) intervals and at each change in duct direction. See drawing for extent of welded stainless steel supply duct required.

- E. Round and Flat Oval Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.
1. Elbows: Diameters 80 through 200 mm (3 through 8 inches) shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
  2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.
  3. Ribbed Duct Option: Lighter gage round/oval duct and fittings may be furnished provided certified tests indicating that the rigidity and performance is equivalent to SMACNA standard gage ducts are submitted.
    - a. Ducts: Manufacturer's published standard gage, G90 coating, spiral lock seam construction with an intermediate standing rib.
    - b. Fittings: May be manufacturer's standard as shown in published catalogs, fabricated by spot welding and bonding with neoprene base cement or machine formed seam in lieu of continuous welded seams.
  4. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA HVAC Duct Construction Standard S3.13. Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the COR.
- F. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards Section 6, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 500 mm (20 inches) wide by 1200 - 1350 mm (48 - 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.

- G. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.
- H. Duct Hangers and Supports: Refer to SMACNA Standards Section IV. Avoid use of trapeze hangers for round duct.

### **2.3 DUCT ACCESS DOORS, PANELS AND SECTIONS**

- A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
  - 1. Each duct mounted coil and humidifier.
  - 2. Each fire damper (for link service), smoke damper and automatic control damper.
  - 3. Each duct mounted smoke detector.
  - 4. For cleaning operating room supply air duct and kitchen hood exhaust duct, locate access doors at 6 m (20 feet) intervals and at each change in duct direction.
- B. Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.
  - 1. For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2-12).
  - 2. For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure 2-11).

### **2.4 FIRE DAMPERS**

- A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 70 degrees C (160 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.
- B. Fire dampers in wet air exhaust shall be of stainless steel construction, all others may be galvanized steel.
  - 1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 1.9 mm (14 gage), required to provide installation equivalent to the damper manufacturer's UL test installation.
  - 2. Submit manufacturer's installation instructions conforming to UL rating test.

3. Combination fire and smoke dampers: Multi-louver or curtain type units meeting all requirements of both dampers shall be used where shown and may be used at the Contractor's option where applicable.

## **2.5 SMOKE DAMPERS**

- A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 450 m/min (1500 fpm). Maximum static pressure loss: 32 Pa (0.13 inch W.G.).
- B. Maximum air leakage, closed damper: 0.32 cubic meters /min/square meter (4.0 CFM per square foot) at 750 Pa (3 inch W.G.) differential pressure.
- C. Minimum requirements for dampers:
1. Shall comply with requirements of Table 6-1 of UL 555S, except for the Fire Endurance and Hose Stream Test.
  2. Frame: Galvanized steel channel with side, top and bottom stops or seals.
  3. Blades: Galvanized steel, parallel type preferably, 300 mm (12 inch) maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for minimum noise generation and pressure drop are preferred for duct mounted dampers.
  4. Shafts: Galvanized steel.
  5. Bearings: Nylon, bronze sleeve or ball type.
  6. Hardware: Zinc plated.
  7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See drawings for required control operation.
- D. Motor operator (actuator): Provide pneumatic or electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

## **2.6 FLEXIBLE AIR DUCT CONNECTORS**

- A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.
- B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 200 mm (8 inches) in diameter



shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.

- C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (foot) of straight duct, at 500 Hz, based on 150 mm (6 inch) duct, of 750 m/min (2500 fpm).
- D. Application Criteria:
1. Temperature range: -18 to 93 degrees C (0 to 200 degrees F) internal.
  2. Maximum working velocity: 1200 m/min (4000 feet per minute).
  3. Minimum working pressure, inches of water gage: 2500 Pa (10 inches) positive, 500 Pa (2 inches) negative.
- E. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

## **2.7 FLEXIBLE CONNECTIONS**

Where duct connections are made to fans and air handling units, install a non-combustible flexible connection of 822 g (29 ounce) neoprene coated fiberglass fabric approximately 150 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50 mm (2 inches) on center. Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack to insure that no vibration is transmitted.

## **2.8 FIRESTOPPING MATERIAL**

Refer to Section 07 84 00, FIRESTOPPING.

## **2.9 THERMOMETER (AIR)**

Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

## **2.10 INSTRUMENT TEST FITTINGS**

- A. Manufactured type with a minimum 50 mm (two inch) length for insulated duct, and a minimum 25 mm (one inch) length for duct not insulated. Test

hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.

- B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, cooling coil, and heat recovery unit.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, particularly regarding coordination with other trades and work in existing buildings.
- B. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
  - 1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
  - 2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
  - 3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
  - 4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.
- C. Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.
- D. Install fire dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test.

- E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- F. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support ducts SMACNA Standards.
- G. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.
- H. Control Damper Installation:
  - 1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
  - 2. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
  - 3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
  - 4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- I. Air Flow Measuring Devices (AFMD): Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.
- J. Low Pressure Duct Liner: Install in accordance with SMACNA, Duct Liner Application Standard.
- K. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by COR. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to

existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

### **3.2 DUCT LEAKAGE TESTS AND REPAIR**

- A. Leak testing company shall be independent of the sheet metal company employed by General Contractor.
- B. Ductwork leak test shall be performed for the entire air distribution supply, return, exhaust system Section by Section including fans, coils and filter Section designated as static pressure class 750 Pa (3 inch W.G.) and above. All supply ductwork less than 500 Pa (3 inch W.G.) shall also be tested where there is no air terminal units employed in the system.
- C. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
- D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- E. All tests shall be performed in the presence of the COR and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the COR and identify leakage source with excessive leakage.
- F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the COR.
- G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
- H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

### **3.3 TESTING, ADJUSTING AND BALANCING (TAB)**

Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

### **3.4 OPERATING AND PERFORMANCE TESTS**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION

- - - E N D - - -

**SECTION 23 36 00**  
**AIR TERMINAL UNITS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

Air terminal units, air flow control valves.

**1.2 RELATED WORK**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION:  
General mechanical requirements and items, which are common to more than one section of Division 23.
- B. Section 23 31 00, HVAC DUCTS AND CASINGS: Ducts and flexible connectors.
- C. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Valve operators.
- D. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Flow rates adjusting and balancing.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Air Terminal Units: Submit test data.
  - 2. Air flow control valves.
- C. Samples: Provide one typical air terminal unit for approval by the Resident Engineer. This unit will be returned to the Contractor after all similar units have been shipped and deemed acceptable at the job site.
- D. Certificates:
  - 1. Compliance with paragraph, QUALITY ASSURANCE.
  - 2. Compliance with specified standards.
- E. Operation and Maintenance Manuals: Submit in accordance with paragraph, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.

## 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (AHRI)/(ARI):  
880-08.....Air Terminals Addendum to ARI 888-98  
incorporated into standard posted 15<sup>th</sup> December  
2002
- C. National Fire Protection Association (NFPA):  
90A-09.....Standard for the Installation of Air  
Conditioning and Ventilating Systems
- D. Underwriters Laboratories, Inc. (UL):  
181-08.....Standard for Factory-Made Air Ducts and Air  
Connectors
- E. American Society for Testing and Materials (ASTM):  
C 665-06.....Standard Specification for Mineral-Fiber  
Blanket Thermal Insulation for Light Frame  
Construction and Manufactured Housing

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Coils:
1. Water Heating Coils:
    - a. ARI certified, continuous plate or spiral fin type, leak tested at 2070 kPa (300 PSI).
    - b. Capacity: As indicated, based on scheduled entering water temperature.
    - c. Headers: Copper or Brass.
    - d. Fins: Aluminum, maximum 315 fins per meter (8 fins per inch).
    - e. Tubes: Copper, arrange for counter-flow of heating water.
    - f. Water Flow Rate: Minimum 0.032 Liters/second (0.5 GPM).
    - g. Provide vent and drain connection at high and low point, respectively of each coil.
    - h. Coils shall be guaranteed to drain.

- B. Labeling: Control box shall be clearly marked with an identification label that lists such information as nominal CFM, maximum and minimum factory-set airflow limits, room number served, coil type and coil connection orientation, where applicable.
- C. Factory calibrate air terminal units to air flow rate indicated. All settings including maximum and minimum air flow shall be field adjustable.
- D. Dampers with internal air volume control: See section 23 31 00 HVAC DUCTS and CASINGS.
- E. Terminal Sound Attenuators: See Section 23 31 00 (HVAC DUCTS AND CASINGS).

## **2.2 AIR TERMINAL UNITS (BOXES)**

- A. General: Factory built, pressure independent units, factory set-field adjustable air flow rate, suitable for single duct applications. Use of dual-duct air terminal units is not permitted. Clearly show on each unit the unit number and factory set air volumes corresponding to the contract drawings. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC work assumes factory set air volumes. Coordinate flow controller sequence and damper operation details with the drawings and Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. All air terminal units shall be brand new products of the same manufacturer.
- B. Capacity and Performance: The Maximum Capacity of a single terminal unit shall not exceed 566 Liters/second (1,200 CFM) with the exception of operating rooms and Cystoscopy rooms, which shall be served by a single air terminal unit at a maximum of 1,250 Liters/second (3,000 CFM).
- C. Sound Power Levels:  
Equipment schedule shall show the sound power levels in all octave bands. Terminal sound attenuators shall be provided, as required, to meet the intent of the design.
- D. Casing: Unit casing shall be constructed of galvanized steel no lighter than 0.85 mm (22 Gauge). Air terminal units serving the operating rooms and Cystoscopy rooms shall be fabricated without lining. Provide hanger brackets for attachment of supports.

1. Lining material: Suitable to provide required acoustic performance, thermal insulation and prevent sweating. Meet the requirements of NFPA 90A and comply with UL 181 for erosion as well as ASTM C 665 antimicrobial requirements. Insulation shall consist of 13 mm (1/2 IN) thick non-porous foil faced rigid fiberglass insulation of 4-lb/cu.ft, secured by full length galvanized steel z-strips which enclose and seal all edges. Tape and adhesives shall not be used. Materials shall be non-friable and with surfaces, including all edges, fully encapsulated and faced with perforated metal or coated so that the air stream will not detach material. No lining material is permitted in the boxes serving operating rooms and Cystoscopy rooms.
  2. Access panels (or doors): Provide panels large enough for inspection, adjustment and maintenance without disconnecting ducts, and for cleaning heating coils attached to unit, even if there are no moving parts. Panels shall be insulated to same standards as the rest of the casing and shall be secured and gasketed airtight. It shall require no tool other than a screwdriver to remove.
  3. Total leakage from casing: Not to exceed 2 percent of the nominal capacity of the unit when subjected to a static pressure of 750 Pa (3 inch WG), with all outlets sealed shut and inlets fully open.
  4. Octopus connector: Factory installed, lined air distribution terminal. Provide where flexible duct connections are shown on the drawings connected directly to terminals. Provide butterfly-balancing damper, with locking means in connectors with more than one outlet. Octopus connectors and flexible connectors are not permitted in the Surgical Suite.
- E. Construct dampers and other internal devices of corrosion resisting materials which do not require lubrication or other periodic maintenance.
1. Damper Leakage: Not greater than 2 percent of maximum rated capacity, when closed against inlet static pressure of 1 kPa (4 inch WG).
- F. Provide multi-point velocity pressure sensors with external pressure taps.



1. Provide direct reading air flow rate table pasted to box.
- G. Provide static pressure tubes.
- H. Externally powered DDC variable air volume controller and damper actuator to be furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for factory mounting on air terminal units. The DDC controller shall be electrically actuated.
- I. Provide all VAV boxes with room number, or areas being served, with a clearly marked laminate label directly under the VAV box number designation on each individual VAV box.

### **2.3 CLOSED LOOP VENTURI VALVES**

- A. General: Refer equipment schedules for specifications on plans. Mechanical Contractor is fully responsible to coordinate with the Controls Contractor to verify/confirm who is purchasing both these venture valves, and related touchscreen room control panels, prior to submitting bid.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.
- B. Handle and install units in accordance with manufacturer's written instructions.
- C. Support units rigidly so they remain stationary at all times. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.
- D. Locate air terminal units to provide a straight section of inlet duct for proper functioning of volume controls. See VA Standard Detail.

### **3.2 OPERATIONAL TEST**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

- - - E N D - - -

**SECTION 23 37 00**  
**AIR OUTLETS AND INLETS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Air Outlets and Inlets: Diffusers, Registers, and Grilles.

**1.2 RELATED WORK**

- A. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

**1.3 QUALITY ASSURANCE**

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Fire Safety Code: Comply with NFPA 90A.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:  
1. Diffusers, registers, grilles and accessories.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Diffusion Council Test Code:  
1062 GRD-84.....Certification, Rating, and Test Manual 4<sup>th</sup>  
Edition
- C. American Society of Civil Engineers (ASCE):  
ASCE7-05.....Minimum Design Loads for Buildings and Other  
Structures
- D. American Society for Testing and Materials (ASTM):  
A167-99 (2004).....Standard Specification for Stainless and  
Heat-Resisting Chromium-Nickel Steel Plate,  
Sheet and Strip  
B209-07.....Standard Specification for Aluminum and  
Aluminum-Alloy Sheet and Plate

E. National Fire Protection Association (NFPA):

90A-09.....Standard for the Installation of Air  
Conditioning and Ventilating Systems

F. Underwriters Laboratories, Inc. (UL):

181-08.....UL Standard for Safety Factory-Made Air Ducts  
and Connectors

**PART 2 - PRODUCTS**

**2.1 AIR OUTLETS AND INLETS**

A. Materials:

1. Steel or aluminum. Use aluminum air outlets and inlets for facilities located in high-humidity areas. Exhaust air registers located in combination toilets and shower stalls shall be constructed from aluminum. Provide manufacturer's standard gasket.
2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel.
3. Contractor shall review all ceiling drawings and details and provide all ceiling mounted devices with appropriate dimensions and trim for the specific locations.

B. Air Supply Outlets:

1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar or special tile ceilings, off-white finish, square or round neck connection as shown on the drawings. Provide plaster frame for units in plaster ceilings.
  - a. Square, louver, fully adjustable pattern: Round neck, surface mounting unless shown otherwise on the drawings. Provide equalizing or control grid and volume control damper.
  - b. Louver face type: Square or rectangular, removable core for 1, 2, 3, or 4 way directional pattern. Provide equalizing or control grid and opposed blade damper.
  - c. Perforated face type: Manual adjustment for one-, two-, three-, or four-way horizontal air distribution pattern without change of air volume or pressure. Provide equalizing or control grid and opposed blade over overlapping blade damper. Perforated face diffusers for VAV systems shall have the pattern controller on the inner face, rather than in the neck and designed to discharge air horizontally at the ceiling maintaining a Coanda effect.
  - d. Slot diffuser/plenum:

- 1) Diffuser: Frame and support bars shall be constructed of heavy gauge extruded aluminum. Form slots or use adjustable pattern controllers, to provide stable, horizontal air flow pattern over a wide range of operating conditions.
- 2) Galvanized steel boot lined with 13 mm (1/2 inch) thick fiberglass conforming to NFPA 90A and complying with UL 181 for erosion. The internal lining shall be factory-fabricated, anti-microbial, and non-friable.
- 3) Provide inlet connection diameter equal to duct diameter shown on drawings or provide transition coupling if necessary. Inlet duct and plenum size shall be as recommended by the manufacturer.
- 4) Maximum pressure drop at design flow rate: 37 Pa  
(0.15 inch W.G.)

2. Operating Room Air Distribution Devices:

- a. Devices shall consist of a non-aspirating perforated panel center air supply providing downward airflow over the operating table and fixed nonadjustable multiple slot perimeter panels surrounding the operating table area to provide an air curtain which shall be projected outward from the operating table area at not less than a five degree angle nor more than a 15 degree angle. Velocity of air distribution at operating table height shall not exceed 12 m/min (40 feet per minute) for the center supply or 15 m/min (50 feet per minute) for the air curtain. Perforated pressure plates shall be provided over the perimeter and center air distribution faces to equalize pressure and airflow throughout the system.
- b. All components of the system inside the operating room shall be fabricated of either:
  1. Add Option: 1.0 mm (20 Gauge) thick 18-8 stainless steel (ASTM A167), No. 4 finish
  2. Base Bid: Manufacturer's standard aluminum construction with sterile white enamel finish.
- c. All distribution components and pressure plates shall be attached to the face panels at both the perimeter and center. The face panels shall be retained with 1/4 turn fasteners. Plenums shall be supplied by the manufacturer and shall be sized to permit them to be easily wiped out by hand with germicidal solution for sterilization purposes and all horizontal corners of the plenums shall have a minimum radius of 20 mm

(3/4 inch). Connecting elbows shall be radialized and be sized to permit manual sterilization of the plenums.

- d. Refer to specifications written directly on drawings for additional requirements, including more specific layout information and bid options for final materials and finishes.
- 
3. Return and Exhaust Registers and Grilles: Provide opposed blade damper without removable key operator for registers.
    1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded aluminum with manufacturer's standard aluminum finish.
    2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 30 mm (1-1/4 inch) margin.
    3. Perforated Face Type: To match supply units.
    4. Grid Core Type: 13 mm by 13 mm (1/2 inch by 1/2 inch) core with 30 mm (1-1/4 inch) margin.
    5. Linear Type: To match supply units.
    6. Door Grilles: Are furnished with the doors.
    7. Egg Crate Grilles: Aluminum or Painted Steel 1/2 by 1/2 by 1/2 inch grid providing 90% free area.
      - a. Heavy extruded aluminum frame shall have countersunk screw mounting. Unless otherwise indicated, register blades and frame shall have factory applied white finish.
      - b. Grille shall be suitable for duct or surface mounting as indicated on drawings. All necessary appurtenances shall be provided to allow for mounting.

## 2.2 HDCR HEAVY-DUTY WELDED CEILING SYSTEM

- A. General: Price HDCR Integrated Ceiling System is designed and manufactured with heavy-duty extruded aluminum T-bar frames that are factory welded in large sub-sections to support diffusers, fill-in panels, and fluorescent light fixtures. Welded sub-sections to be mechanically fastened in the field by installing contractor.
- B. Laminar flow diffuser manufacturer shall furnish extruded aluminum ceiling suspension system to support supply diffusers, fill-in or

- blank-off panels, and light fixtures (by others). Ceiling tees shall have a 1.5" face width and 1.563" overall height. Minimum wall thickness of full tees shall be 0.125 wide with a minimum weight of 0.45lbs. per linear ft. (full tee). All tee and half tee extrusions should include channels along the top side of the stack to support hold-down clips for fill-in panels.
- C. The ceiling suspension system shall be provided in factory heli-arc welded sub-assemblies not to exceed 4'x8'. Framed sub-assemblies shall be mechanically fastened in the field with adjacent sub-assemblies being butted together along the half tees with factory supplied bolts or spring steel U-clips.
- D. All tees and half tees shall be pre-punched on 4.85" centers for attachment to minimum 12 gauge pre-stressed suspension wire on 48" centers. Systems shall be designed to support 15lbs/ft<sup>2</sup> when installed per ASTM C636.
- E. Manufacturer shall provide 0.125" thick, closed-cell polyethylene gasket tape to be field applied to all tees and half tees that support diffusers, fill-in panels, and light fixtures. Fill-in panels to be held down using factory supplied spring clips to ensure a tight seal against the closed cell-cell gasket.
- F. The finish of the Integrated Ceiling System shall be B12 baked-on powder coat to match appearance of laminar flow diffusers and fill-in panels. Paint finish must demonstrate no deterioration when tested in accordance with ASTM D4752 (MEK double rub) paint durability tests.
- G. All components of the integrated ceiling system shall be from a single manufacturer and shall be in accordance with ASHRAE Standard 170 and FGI 2010
- H. Refer to specifications written directly on drawings for additional requirements, including more specific layout information and bid options for final fabrication materials and finishes.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, particularly regarding coordination with other trades and work in existing buildings.

B. Protection and Cleaning: Protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by Resident Engineer. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

### **3.2 OPERATING ROOM CEILING SYSTEM**

A. General: Install and coordinate system and components per manufacturer's recommended guidelines and per ASTM C636. Verification of ceiling rough opening dimensions and all mechanical and electrical work by installing contractor to be completed prior to installation of integrated ceiling system.

#### **B. INSTALLATION**

Prior to installation of integrated ceiling system, contractor shall verify all diffusers, fill-in panels, and framing sub-sections are consistent with factory submittals.

Framing sub-sections shall be assembled in accordance with manufacturer's installation instructions and approved submittal drawings.

Suspended ceiling hangers shall be plumb and shall not interfere with other objects within the ceiling space that is not part of the supporting structural or integrated ceiling system. Contractor must confirm in writing that the intended space is ready for installation.

### **3.3 TESTING, ADJUSTING AND BALANCING (TAB)**

Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

### **3.4 OPERATING AND PERFORMANCE TESTS**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION

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**SECTION 23 81 23**  
**COMPUTER-ROOM AIR-CONDITIONERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies process cooling split systems air conditioning unit.
- B. Definitions:
  - 1. Energy Efficiency Ratio (EER): A ratio calculated by dividing the cooling capacity in Btuh by the power input in watts at any given set of rating conditions, expressed in Watts (Btu/h) per watt.
  - 2. Coefficient of Performance (COP): A ratio calculated by dividing the change in heating or cooling capacity (Btu/h) to the energy consumed by the system (kW), expressed in Btu/kWh.
  - 3. Unitary (AHRI): Consists of one or more factory-made assemblies, which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function.
  - 4. CRAC Units: Computer Room Air Conditioning Units.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS: Requirements for pre-test of equipment.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION: Requirements and for ducts and piping insulation.
- D. Section 23 31 00, HVAC DUCTS and CASINGS: Requirements for sheet metal ducts and fittings.
- E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.
- F. Section 23 05 93: TESTING, ADJUSTING, and BALANCING FOR HVAC: Requirements for testing, adjusting and balancing of HVAC system.
- G. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

**1.3 QUALITY ASSURANCE**

Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**1.4 SUBMITTALS**

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.



- B. Manufacturer's Literature and Data, rated capacities (at design indoor and outdoor conditions), EER/COP, operating characteristics, required specialties and accessories. Submit published catalog selection data showing equipment ratings and compliance with required sensible ratio.
  - 1. Indoor Air Conditioning Unit
- C. Submit detailed equipment assemblies with dimensions, operating weights, required clearances.
- D. Submit wiring diagrams for power, alarm and controls.
- E. Certification: Submit, simultaneously with shop drawings, a proof of certification:
- F. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

#### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed Spec):
  - 00-A-374C-95.....Air-Conditioners with Remote Condensing Units or Remote Air-cooled and Water-Cooled Condenser Units, Unitary
  - TT-C-490D-93.....Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
- C. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Standards:
  - 210/240-08.....Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
  - 340/360-07.....Performance Rating of Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment
  - 410-01.....Forced-Circulation Air-Cooling and Air-Heating Coils
  - 460-2005.....Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
  - 520-04.....Performance Rating of Positive Displacement Condensing Units
  - AHRI-DCPP.....Directory of Certified Product Performance - Applied Directory of Certified Products
- D. Air Movement and Control Association (AMCA):
  - 210-07.....Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating (ANSI)

- 410-96.....Recommended Safety Practices for Users and  
Installers of Industrial and Commercial Fans
- E. American Society of Heating, Refrigerating, and Air-Conditioning  
Engineers Inc. (ASHRAE):
  - 15-10.....Safety Standard for Refrigeration Systems (ANSI)
  - 90.1-10.....Energy Standard for Buildings except Low-Rise  
Residential Buildings (ANSI Approved; IESNA Co-  
sponsored)
  - 2008 Handbook.....HVAC Systems and Equipment
  - 2010 Handbook.....Refrigeration
  - 52.1-92.....Gravimetric and Dust-Spot Procedures for Testing  
Air-Cleaning Devices used in General Ventilation  
for Removing Particulate Matter
- F. National Electrical Manufacturer's Association (NEMA):
  - MG 1-09 (R2010).....Motors and Generators (ANSI)
- G. National Fire Protection Association (NFPA) Publications:
  - 70-11.....National Electrical Code
  - 90A-09.....Standard for the Installation of Air-  
Conditioning and Ventilating Systems

## **PART 2 - PRODUCTS**

### **2.1 FLOOR-MOUNTED UNITS 24 KW (7 TONS) AND SMALLER**

- A. Description: Self-contained, factory assembled, prewired, and prepiped;  
consisting of cabinet, fan, filters, and controls; for vertical floor  
mounting in upflow or downflow configuration.
- B. Cabinet and Frame: Welded tubular-steel frame with removable steel  
panels with baked-enamel finish, insulated with 1-inch- (25-mm-) thick  
duct liner.
- C. Floor Stand: Welded tubular steel, 300 mm (12 inches), with adjustable  
legs and vibration isolation pads.
- D. Finish of Interior Surfaces: Surfaces in contact with the airstream  
shall comply with requirements in ASHRAE 62.1-20010.
- E. Supply-Air Fan:
  - 1. Forward-Curved Centrifugal Fan: Provide with adjustable V-belt drive.
- F. Compressor: Hermetic, scroll with oil strainer, internal motor overload  
protection, resilient suspension system, and crankcase heater.
- G. Integral, Water-Cooled Refrigerant Condenser: Brazed-plate type with  
liquid-line stop valve and head-pressure-actuated, two-way regulating  
valve.
  - 1. Cooling Medium: Propylene Glycol solution

- H. Hydronic Cooling Coil: Seamless copper tubes expanded into aluminum fins with modulating three-way control valve.
  - 1. Cooling Medium: Water
  - 2. Coil assembly shall be mounted over stainless-steel drain pan complying with ASHRAE 62.1-2010 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.
- I. Remote Air-Cooled, Glycol-Solution Cooler: For VA central high temp loop (with primary chilled water service as shown on drawings).
- J. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- K. Filter: 100-mm (4-inch) thick, disposable, glass-fiber media.
  - 1. MERV Rating: 11, according to ASHRAE 52.2.
- L. Infrared Humidifier: High-intensity quartz lamps mounted above stainless-steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; prepiped and located in bypass airstream; with flush-cycle timer and solenoid drain valve.
- M. Control: Fully modulating to provide gradual 0 to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.
- N. Drain Cycle: Field-adjustable drain duration and drain interval.
- O. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- P. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature and humidity control modules, time-delay relay, heating contactor, and high-temperature thermostat. Provide solid-state, wall-mounted control panel with start-stop switch, adjustable humidity set point, and adjustable temperature set point.
- Q. DDC Interface: Provide connection to DDC system.

## **2.2 FAN MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
- B. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0. Provide high static fan motors for ducted applications.
- C. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

### **2.3 SPECIAL TOOLS**

If any part of equipment furnished under these specifications requires a special tool for assembly, adjustment, setting, or maintenance and the tool is not readily available from the commercial tool market, furnish the necessary tools with equipment as a standard accessory

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Handle and install refrigeration units and accessories in accordance with the instructions and recommendations of the manufacturer.
- B. Coordinate installation of Computer room Air Conditioning Units with Computer room access flooring installer.
- C. Field Piping: Glycol Piping, Hot water Piping, Steam and Condensate Piping, as specified in specification Section 23 21 13, HYDRONIC PIPING.
- D. Fill glycol system with 50 percent glycol mixture and perform start-up procedures as recommended by the manufacturer.
- E. Electrical System Connections and Equipment Ground: As specified in Division 26 Sections.

### **3.2 CONNECTIONS**

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to machine to allow service and maintenance.
- D. Water and Drainage Connections: Comply with applicable requirements in Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING and Section 22 11 00, FACILITY WATER DISTRIBUTION. Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.
- E. Retain first paragraph below for units with hot-water coils.
- F. Hot-Water Heating Piping: Comply with applicable requirements in Section 23 21 13, HYDRONIC PIPING. Provide shutoff valves in inlet and outlet piping to heating coils.
- G. Condenser-Water Piping: Comply with applicable requirements in Section 23 21 13, HYDRONIC PIPING. Provide shutoff valves in water inlet and outlet piping on water-cooled units.

### **3.3 FIELD QUALITY CONTROL**

#### **A. Tests and Inspections:**

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

#### **B. After startup service and performance test, change filters and flush humidifier.**

### **3.4 INSTRUCTIONS**

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of computer room air conditioning equipment.

### **3.5 STARTUP AND TESTING**

- #### **A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.**

### **3.6 COMMISSIONING**

- #### **A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.**
- #### **B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.**

### **3.7 DEMONSTRATION AND TRAINING**

- #### **A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.**
- #### **B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS.**

- - - E N D - - -

**SECTION 23 84 00**  
**HUMIDITY CONTROL EQUIPMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies electronic canister humidifiers.

**1.2 RELATED WORK**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- B. Section 23 31 00, HVAC DUCTS AND CASINGS: Requirements for sheet metal ducts and fittings.
- C. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.
- D. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Requirements for testing, adjusting and balancing of HVAC system.
- E. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

**1.3 QUALITY ASSURANCE**

- A. Refer to the GENERAL CONDITIONS.
- B. Refer to specification Section 01 00 00, GENERAL REQUIREMENTS for performance tests and instructions to VA personnel.
- C. Refer to paragraph, QUALITY ASSURANCE, in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- D. Unit(s) shall be provided by a manufacturer who has been manufacturing desiccant dehumidifiers and have been in satisfactory service for at least three (3) years.

**1.4 SUBMITTALS**

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Technical data on design operating inlet and outlet conditions, air flows with diagram showing air volumes and conditions throughout the system, dehumidification capacity, filtration and fan motor and electrical power data.
  - 2. A general arrangement diagram with overall dimensions showing all major components with overall dimensions, utility and duct work connections, bolting arrangement, operating weight and required service and equipment removal clearances.

- C. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- D. Submit unit control system documentation required for interface with BACnet protocol DDC control system. Submit BACnet compliant Protocol Implementation Conformance Statement (PICS) for all controllers.
- E. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- F. Certificate: Evidence of satisfactory performance on three similar installations.
- G. Performance test report: In accordance with PART 3.
- H. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air-conditioning, Heating and Refrigeration Institute (AHRI)  
410-01.....Forced-Circulation Air-Cooling and Air-Heating Coils
- C. Air Movement and Control Association (AMCA):  
99-10.....Standards Handbook  
210-07.....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI)  
301-06.....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI)
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)  
52.2-07.....METHOD OF TESTING General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size (ANSI)  
62.1-10.....Ventilation for Acceptable Indoor Air Quality (ANSI)
- E. American Bearing Manufacturers Association (ABMA)

9-1990 (R2008).....Load Ratings and Fatigue Life for Ball  
Bearings (ANSI)

F. National Fire Protection Association (NFPA)

90A-09.....Standard for the Installation of Air-  
Conditioning and Ventilating Systems

70-0511.....National Electrical Code

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish.
- C. Comply with manufacturer's rigging and installation instructions.

#### **1.7 PROJECT CONDITIONS**

Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, fan has been test run, all piping is connected and energized and all wiring complete and tested.

### **PART 2 - PRODUCTS**

#### **2.1 ELECTRODE STEAM HUMIDIFICATION SYSTEM**

- A. Provide electrode humidifier generating mineral-free, sterile steam from a potable water supply Packaged unit, wall mounted, atmospheric steam generation using an electrode steam cylinder[s]. Resistive element technology and boiler steam (pressure steam) technology not acceptable. Humidifier Specifications | 33
- B. Unit[s] to be complete with:
  - a. Touchscreen controller with standard building automation connectivity:
    - i. Intuitive touchscreen control with color graphic user interface.
    - ii. Standard building automation communication protocols BACnet IP, BACnet MSTP and Modbus. Additional hardware required for building automation communication not acceptable.
    - iii. Standard Nortec Online connectivity for remote monitoring and factory diagnostic.



- iv. Embedded web interface for easy configuration and remote monitoring from any computer with a web browser over a local area network (LAN) connection.
- v. USB interface for new software/feature upload and download of operational information.
- vi. Single or dual channel analog signal acceptance, supporting both demand and transducer control. Ability to control set point from humidifier control when using transducer controls.
- b. Standard remote monitoring
  - i. Integrated hardware and software allows for remote end-user and factory diagnostic of humidifier(s) via the internet.
  - ii. Humidifier parameter data and performance trending data can be exported remotely using the internet.
  - iii. Humidifier will be accessed via the internet by registering humidifier to [www.norteonline.com](http://www.norteonline.com). Controls contractor to provide internet access to humidifier through Ethernet cable with RJ-45 connection.
- c. Packaged system with electrode cylinder technology:
  - i. Cylinder optimized for humidifier capacity and supply voltage. Cylinder must have welded seam to ensure watertight and have high water sensor to prevent overfilling.
  - ii. Durable powder coated steel cabinet with zero side clearance requirement for minimal footprint (excluding distribution attachments).
  - iii. Insulating air gap between plumbing and electrical compartment for increased electronic reliability.
  - iv. Standard internal drain water tempering to ensure maximum 140°F [60°C] drain water. External drain water cooler not acceptable.
  - v. Integral fill cup with minimum 1-inch [25 mm] air gap to prevent back siphoning.
  - vi. Full cylinder indication and pre-notification of automatic shutdown at end of cylinder life.
  - vii. Automatic pulse feature to clean any obstruction from the drain solenoid valve if required.
  - viii. Automatic off-season shut-down [after 3 days of "no call"] will completely drain the cylinder[s] and automatically restart on call for humidity. Adjustable on/off and time

- sequence. Provides extended cylinder life, while ensuring stagnant water does not remain in the system.
- ix. Plumbing door interlock safety switch to allow power interruption when installing or servicing the humidifier.
- d. Auto-Adaptive Control water management:
- i. Advanced water management utilizing the patented Proportional plus Integral Auto-Adaptive Control system for optimal energy efficiency, water usage and cylinder life.
  - ii. 98% thermal efficiency from startup until end of cylinder life.
  - iii. Drains automatically optimized to water conditions to maximize cylinder and reduce water usage.
  - iv. Modulating output between 20% and 100% of rated capacity.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Follow equipment manufacturer's written instructions for handling and installation of equipment.
  - B. Adjust seals and purge of rotating wheels as recommended by the manufacturer.
  - C. Verify correct settings and installation of controls.
  - E. Install vibration-control devices.
- 2. Floor-Mounted Units: Support on concrete bases using neoprene pads having a minimum static deflection of 6.35 mm (0.25 inch). Secure units to anchor bolts installed in concrete bases.
  - 3. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers.

#### **3.2 CONNECTIONS**

- A. Connect condensate drain pans using minimum DN 32 NPS 1-1/4copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan, and install clean out at changes in direction.
- B. Ground equipment according to Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- C. Connect wiring according to Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If

manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.3 STARTUP SERVICE**

- A. Perform the following final checks before startup:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connection to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Perform cleaning and adjusting specified in this Section.

### **3.4 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Adjust initial temperature and humidity set points.

### **3.5 CLEANING**

- A. Clean units internally, on completion of installation, according to manufacturer's written instructions.

### **3.6 INSTRUCTIONS**

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of desiccant dehumidifiers.

### **3.7 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

### **3.8 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS.

- - - E N D- - -

**SECTION 26 05 11**  
**REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, cable, panelboards, and other items and arrangements for the specified items are shown on drawings.
- C. Wiring ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.

**1.2 MINIMUM REQUIREMENTS**

- A. References to the International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

**1.3 TEST STANDARDS**

- A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., standards where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
  - 1. Listed; Equipment, materials, or services included in a list published by an organization that is acceptable to the authority

- having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled; Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
  3. Certified; equipment or product which:
    - a. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
    - b. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
    - c. Bears a label, tag, or other record of certification.
  4. Nationally recognized testing laboratory; laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

#### **1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)**

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
  1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
  2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of

notification that service is needed. Submit name and address of service organizations.

#### **1.5 APPLICABLE PUBLICATIONS**

Applicable publications listed in all Sections of Division are the latest issue, unless otherwise noted.

#### **1.6 MANUFACTURED PRODUCTS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class or type of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
  - 2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
  - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

#### **1.7 EQUIPMENT REQUIREMENTS**

Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to

branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

#### **1.8 EQUIPMENT PROTECTION**

- A. Equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
  - 1. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to switchgear, switchboards, panelboards, transformers, motor control centers, motor controllers, uninterruptible power systems, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
  - 2. During installation, equipment shall be protected against entry of foreign matter; and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
  - 3. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
  - 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
  - 5. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

#### **1.9 WORK PERFORMANCE**

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
  - 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
  3. Before initiating any work, a job specific work plan must be developed by the contractor with a peer review conducted and documented by the COR and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used and exit pathways.
  4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COR.
- D. For work on existing stations, arrange, phase and perform work to assure electrical service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interferences.

#### **1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working spaces shall not be less than specified in the NEC for all voltages specified.
- C. Inaccessible Equipment:
  1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
  2. "Conveniently accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

#### **1.11 EQUIPMENT IDENTIFICATION**

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers,



individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

- B. Nameplates for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Nameplates for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch [12mm] high. Nameplates shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.
- C. All Receptacles shall be labeled with a 1/2" white label with lettering indicating panel and circuit number placed on the plate just above the top of the receptacle. Use black lettering for normal power and red lettering for emergency power. See 26 27 26 Wiring Devices for additional information.
- D. All low-voltage devices shall be labeled in accordance with VA Standards. See 27 12 00 Telecommunications Cabling Expansion for additional information.

#### **1.12 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
  - 1. Mark the submittals, "SUBMITTED UNDER SECTION\_\_\_\_\_".
  - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  - 3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements.  
Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
3. Parts list which shall include those replacement parts recommended by the equipment manufacturer.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
  - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
  - b. A control sequence describing start-up, operation, and shutdown.
  - c. Description of the function of each principal item of equipment.
  - d. Installation instructions.
  - e. Safety precautions for operation and maintenance.
  - f. Diagrams and illustrations.
  - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
  - h. Performance data.

- i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
  - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of manuals together with shop drawings.
- H. After approval and prior to installation, furnish the COR with one sample of each of the following:
- 1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
  - 2. Each type of conduit coupling, bushing and termination fitting.
  - 3. Conduit hangers, clamps and supports.
  - 4. Duct sealing compound.
  - 5. Each type of receptacle, toggle switch, occupancy sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

#### **1.13 SINGULAR NUMBER**

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

#### **1.15 ACCEPTANCE CHECKS AND TESTS**

The contractor shall furnish the instruments, materials and labor for field tests.

#### **1.16 TRAINING**

- A. Training shall be provided in accordance with Article 1.25, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the COR at least 30 days prior to the planned training.

- - - E N D - - -

**SECTION 26 05 19**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

**1.2 RELATED WORK**

- A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 FACTORY TESTS**

- A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

**1.5 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Submit the following data for approval:
      - 1) Electrical ratings and insulation type for each conductor and cable.
      - 2) Splicing materials and pulling lubricant.
  - 2. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

#### 1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
- B. American Society of Testing Material (ASTM):
  - D2301-10.....Standard Specification for Vinyl Chloride  
Plastic Pressure-Sensitive Electrical  
Insulating Tape
  - D2304-10.....Test Method for Thermal Endurance of Rigid  
Electrical Insulating Materials
  - D3005-10.....Low-Temperature Resistant Vinyl Chloride  
Plastic Pressure-Sensitive Electrical  
Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
  - WC 70-09.....Power Cables Rated 2000 Volts or Less for the  
Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
  - 70-14.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
  - 44-10.....Thermoset-Insulated Wires and Cables
  - 83-08.....Thermoplastic-Insulated Wires and Cables
  - 467-07.....Grounding and Bonding Equipment
  - 486A-486B-03.....Wire Connectors
  - 486C-04.....Splicing Wire Connectors
  - 486D-05.....Sealed Wire Connector Systems
  - 486E-09.....Equipment Wiring Terminals for Use with  
Aluminum and/or Copper Conductors
  - 493-07.....Thermoplastic-Insulated Underground Feeder and  
Branch Circuit Cables
  - 514B-04.....Conduit, Tubing, and Cable Fittings

SPEC WRITER NOTE: Delete between // ----  
// if not applicable to project. Also  
delete any other item or paragraph not

applicable to the section and renumber  
the paragraphs.

## **PART 2 - PRODUCTS**

### **2.1 CONDUCTORS AND CABLES**

- A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.
- B. All conductors shall be copper.
- C. Single Conductor and Cable:
  - 1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
  - 2. No. 8 AWG and larger: Stranded.
  - 3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
  - 4. Insulation: THHN-THWN and XHHW-2. **XHHW-2 shall be used for isolated power systems.**
- D. Home Run sizing.
  - a. All home runs shall be minimum size 10 AWG unless noted otherwise.
  - b. A home run in conduit is defined as the electrical cable that carries the power from the circuit breaker panel to the first electrical box or connection point.
  - c. A home run in a wireway is defined as the cable that carries the power from the circuit breaker panel to the point where it exits the wireway and enters another raceway system.
- E. Contractor shall provide the length of all feeder cables for overcurrent protective device coordination study.
- F. Color Code:
  - 1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
  - 2. No. 8 AWG and larger: Color-coded using one of the following methods:
    - a. Solid color insulation or solid color coating.
    - b. Stripes, bands, or hash marks of color specified.
    - c. Color using 19 mm (0.75 inches) wide tape.
  - 4. For modifications and additions to existing wiring systems, color-coding shall conform to the existing wiring system.

5. Conductors shall be color-coded as follows for building 70  
(contractor to verify):

208/120 V	Phase	480/277 V
Black	A	Yellow
Blue	B	Brown
Red	C	Orange
White *	Neutral	Gray *
* or white with colored (other than green) tracer respective of the phase conductor.		

6. Multiwire branch circuits are NOT allowed unless specifically specified in the drawings. Each circuit must have its own neutral.
7. Lighting circuit "switch legs", and 3-way and 4-way switch "traveling wires," shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color-coding in the field with the COR.
8. Color code for isolated power system wiring shall be in accordance with the NEC.

## 2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
  2. The integral insulator shall have a skirt to completely cover the stripped conductors.
  3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
  2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
  3. Splice and insulation shall be product of the same manufacturer.

4. All bolts, nuts, and washers used with splices shall be zinc-plated steel.

D. Above Ground Splices for 250 kcmil and Larger:

1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
3. Splice and insulation shall be product of the same manufacturer.

**2.3 CONNECTORS AND TERMINATIONS**

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

**2.4 CONTROL WIRING**

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

**2.5 WIRE LUBRICATING COMPOUND**

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
- B. Shall not be used on conductors for isolated power systems.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.
- B. Install all conductors in raceway systems, except where direct burial or HCF Type AC or MC cables are used. Install in raceway systems as far as practically possible before changing over to HCF Type AC or MC Cable.



- C. Splice conductors only in outlet boxes, junction boxes, or pull boxes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Conductor and Cable Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
  - 2. Use nonmetallic pull ropes.
  - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
  - 4. All conductors in a single conduit shall be pulled simultaneously.
  - 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- I. No more than three branch circuits shall be installed in any one conduit.
- J. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

### **3.2 INSTALLATION IN MANHOLES (NOT USED)**

### **3.3 SPLICE AND TERMINATION INSTALLATION**

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

### **3.4 CONDUCTOR IDENTIFICATION**

- A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns

for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pull boxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

### **3.5 FEEDER CONDUCTOR IDENTIFICATION**

- A. In each interior pull box and each underground manhole and hand hole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

### **3.6 EXISTING CONDUCTORS**

- A. Unless specifically indicated on the plans, existing conductors shall not be reused.

### **3.7 CONTROL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

### **3.8 CONTROL WIRING IDENTIFICATION**

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.

### **3.9 DIRECT BURIAL CABLE INSTALLATION (NOT USED)**

### **3.10 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests: Inspect physical condition.
  - 2. Electrical tests:
    - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
    - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until

reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.

c. Perform phase rotation test on all three-phase circuits.

---END---

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**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.
- B. "Grounding electrode system" refers to all electrodes required by NEC.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:
  - 1. Certification that the materials and installation is in accordance with the drawings and specifications.
  - 2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

**1.4 APPLICABLE PUBLICATIONS**

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the

extent referenced. Publications are referenced in the text by the basic designation only.

- A. American Society for Testing and Materials (ASTM):
  - B1-2001.....Standard Specification for Hard-Drawn Copper Wire
  - B8-2004.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- C. National Fire Protection Association (NFPA):
  - 70-2014.....National Electrical Code (NEC)
  - 99-2005.....Health Care Facilities
- D. Underwriters Laboratories, Inc. (UL):
  - 44-2005 .....Thermoset-Insulated Wires and Cables
  - 83-2003 .....Thermoplastic-Insulated Wires and Cables
  - 467-2004 .....Grounding and Bonding Equipment
  - 486A-486B-2003 .....Wire Connectors

## **PART 2 - PRODUCTS**

### **2.1 GROUNDING AND BONDING CONDUCTORS**

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm<sup>2</sup> (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.
- D. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

## **2.2 GROUND RODS (NOT USED)**

## **2.3 SPLICES AND TERMINATION COMPONENTS**

Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

## **2.4 GROUND CONNECTIONS**

### **A. Above Grade:**

1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

## **2.5 EQUIPMENT RACK AND CABINET GROUND BARS**

Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x 3/4 inch).

## **2.6 GROUND TERMINAL BLOCKS**

At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

## **2.7 SPLICE CASE GROUND ACCESSORIES**

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.

# **PART 3 - EXECUTION**

## **3.1 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. System Grounding:
  1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
  2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
  3. Isolation transformers and isolated power systems shall not be system grounded.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes,

cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

- D. Special Grounding: For patient care area electrical power system grounding, conform to NFPA 99, and NEC.

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

### **3.3 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS (NOT USED)**

### **3.4 SECONDARY EQUIPMENT AND CIRCUITS**

- A. Metallic Piping, Building Steel, and Supplemental Electrode(s):
1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all installed metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
  2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- B. Switchgear, Switchboards, Unit Substations, and Motor Control Centers:
1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
  2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
  3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
- C. Transformers:
1. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system.
- D. Conduit Systems:
1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
  2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a



- grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- E. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- F. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
  2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
  3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- G. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- H. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
- I. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- J. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- K. Panelboard Bonding: The equipment grounding terminal buses of the normal and essential branch circuit panelboards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than 16 mm<sup>2</sup> (10 AWG). These conductors shall be installed in rigid metal conduit.

### **3.5 CORROSION INHIBITORS**

When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

### **3.6 CONDUCTIVE PIPING**

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the gases and suction piping, at the outlets, directly to the room or patient ground bus.

### **3.7 LIGHTNING PROTECTION SYSTEM (NOT USED)**

### **3.8 ELECTRICAL ROOM GROUNDING**

- A. Building Earth Ground Busbars: Provide ground busbar hardware at each electrical room and connect to pigtail extensions of the building grounding ring.

### **3.9 WIREWAY GROUNDING**

- A. Ground and Bond Metallic Wireway Systems as follows:
  - 1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm<sup>2</sup> (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
  - 2. Install insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
  - 3. Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.

### **3.10 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Government. Final tests shall assure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground

resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

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**SECTION 26 05 33**  
**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.
- C. For typical branch circuits use wireway or EMT as far as possible. Flexible metal conduit is to be used only where necessary

**1.2 RELATED WORK**

- A. Section 06 10 00, ROUGH CARPENTRY: Mounting board for telephone closets
- B. Section 07 60 00, FLASHING AND SHEETMETAL: Fabrications for the deflection of water away from the building envelope at penetrations.
- C. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.
- D. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- E. Section 09 91 00, PAINTING: Identification and painting of conduit and other devices.
- F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- H. Section 27 05 33 RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

**1.3 QUALITY ASSURANCE**

Refer to paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, furnish the following:

- A. Shop Drawings:
  - 1. Size and location of main feeders;
  - 2. Size and location of panels and pull boxes

3. Layout of required conduit penetrations through structural elements.
4. Submit the following data for approval:
  - a. Raceway types and sizes
  - b. Conduit bodies, connectors, and fittings.
  - c. Junction and pull boxes, types, and sizes.
- B. Certification: Two weeks prior to final inspection, submit the following:
  1. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):
  - C80.1-05 . . . . . Electrical Rigid Steel Conduit
  - C80.3-05 . . . . . Steel Electrical Metal Tubing
  - C80.6-05 . . . . . Electrical Intermediate Metal Conduit
- C. National Fire Protection Association (NFPA):
  - 70-2014.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
  - 1-05.....Flexible Metal Conduit
  - 5-11.....Surface Metal Raceway and Fittings
  - 6-07.....Rigid Metal Conduit
  - 50-95.....Enclosures for Electrical Equipment
  - 360-13.....Liquid-Tight Flexible Steel Conduit
  - 467-13.....Grounding and Bonding Equipment
  - 514A-13.....Metallic Outlet Boxes
  - 514B-12.....Fittings for Cable and Conduit
  - 514C-07.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
  - 651-11.....Schedule 40 and 80 Rigid PVC Conduit
  - 651A-11.....Type EB and A Rigid PVC Conduit and HDPE Conduit
  - 797-07.....Electrical Metallic Tubing
  - 1242-06.....Intermediate Metal Conduit
- E. National Electrical Manufacturers Association (NEMA):

- TC-2-13.....Electrical Polyvinyl Chloride (PVC) Tubing and  
Conduit
- TC-3-13.....PVC Fittings for Use with Rigid PVC Conduit and  
Tubing
- FB1-12.....Fittings, Cast Metal Boxes and Conduit Bodies  
for Conduit, Electrical Metallic Tubing and  
Cable
- FB2.10-13.....Selection and Installation Guidelines for Fittings  
for use with Non-Flexible Conduit or Tubing  
(Rigid Metal Conduit, Intermediate Metallic  
Conduit, and Electrical Metallic Tubing)
- FB2.20-12.....Selection and Installation Guidelines for Fittings  
for use with Flexible Electrical Conduit and  
Cable
- F. American Iron and Steel Institute (AISI):  
S100-2007.....North American Specification for the Design of  
Cold-Formed Steel Structural Members

## **PART 2 - PRODUCTS**

### **2.1 MATERIAL**

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch) flexible conduit may be used for tap connections to recessed lighting fixtures. See specification section 27 05 33 for communications systems raceway minimum requirements.
- B. Conduit:
1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
  2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
  3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
  4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
  5. Flexible galvanized steel conduit: Shall Conform to UL 1.
  6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
  7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
  8. Surface metal raceway: Shall Conform to UL 5.
- C. Conduit Fittings:
1. Rigid steel and IMC conduit fittings:
    - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.

- b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  - d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
  - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
  - f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Rigid aluminum conduit fittings:
- a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
  - b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
  - c. Set screw fittings: Not permitted for use with aluminum conduit.
3. Electrical metallic tubing fittings:
- a. Fittings shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Couplings and connectors:
    - 1) Compression: Concrete tight and rain tight, with connectors having insulated throats. Gland and ring compression type couplings and connectors.
    - 2) Setscrew: Use set screw type couplings of case-hardened steel with hex-head and cup point to firmly seat in wall of conduit for positive grounding.
  - d. Indent type connectors or couplings are prohibited.



- e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- 4. Flexible steel conduit fittings:
  - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp type, with insulated throat.
- 5. Liquid-tight flexible metal conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- 6. Surface metal raceway fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
- 7. Expansion and deflection couplings:
  - a. Conform to UL 467 and UL 514B.
  - b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for equipment ground conductors.
  - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
  - 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
  - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  - 3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
  - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
  - 1. UL-50 and UL-514A.

2. Rustproof cast metal where required by the NEC or shown on drawings.
  3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
  4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall.  
For single gang applications, 'box-to-stud mounting bracket with device cover' are NOT allowed.
  5. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

### **PART 3 - EXECUTION**

#### **3.1 PENETRATIONS**

- A. Cutting or Holes:
1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the VA Project Manager prior to drilling through structural sections.
  2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the VA Project Manager as required by limited working space.
- B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke, and gases as specified in Section 07 84 00, FIRESTOPPING.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.
- D. INTERSTITIAL FLOOR PENETRATION:
1. When conduits are to be run through the interstitial deck they must be installed as shown in Image 3.1.B.1 at the end of this specification.

#### **3.2 INSTALLATION, GENERAL**

- A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.

B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where specifically "accepted" by NEC Article 517.

C. Install conduit as follows:

1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
6. Independently support conduit at 8'0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Do not use aluminum conduits in wet locations.
12. Conduit bodies shall only be used for changes in direction, and shall not contain splices.
13. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.

D. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown on drawings.
  2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the VA Project Manager.
  3. All J-Boxes shall be labeled with the circuit numbers and panel numbers.
- F. FIRESTOPPING systems or devices used for penetrations by plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall have following properties:
1. Classified for use with the particular type of penetrating material used.
  2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using FIRESTOPPING systems that allow unrestricted cable changes without damage to the seal.
  3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and, water sealant.
  4. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.
  5. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- G. Waterproofing systems or devices used for penetrations by plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall be nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

### **3.3 CONCEALED WORK INSTALLATION**

- A. In Concrete:
1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
  2. Align and run conduit in direct lines.
  3. Install conduit through concrete beams only when the following occurs:
    - a. Where shown on the structural drawings.

- b. As approved by the COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
- 4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
  - a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
  - b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
  - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
- 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.
- B. Furred or Suspended Ceilings and in Walls:
  - 1. Conduit for conductors above 600 volts:
    - a. Rigid steel or rigid aluminum.
    - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
  - 2. Conduit for conductors 600 volts and below:
    - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
  - 3. Align and run conduit parallel or perpendicular to the building lines.
  - 4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture. NO 'Daisy Chaining' light fixtures.
  - 5. Tightening setscrews with pliers is prohibited.

#### **3.4 EXPOSED WORK INSTALLATION**

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for conductors above 600 volts:
  - 1. Rigid steel or rigid aluminum.
  - 2. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
- C. Conduit for Conductors 600 volts and below:
  - 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.

- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- G. Surface metal raceways: Use only where shown.
- H. Painting:
  - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
  - 2. Paint all conduits containing cables rated over 600V safety orange.  
Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50mm (2-inch) high black numerals and letters, showing the cable voltage rating.  
Provide legends where conduits pass through walls and floors at maximum 6m (20-feet) intervals in between.

### **3.5 DIRECT BURIAL INSTALLATION (NOT USED)**

### **3.6 HAZARDOUS LOCATIONS (NOT USED)**

### **3.7 WET OR DAMP LOCATIONS**

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.
- C. Unless otherwise shown, use rigid steel or IMC conduit within 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.
- D. Conduit run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4M (8-feet) with 9mm (3.8-inch galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

### **3.8 MOTORS AND VIBRATING EQUIPMENT**

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity-laden atmosphere, corrosive atmosphere,

water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

### **3.9 EXPANSION JOINTS**

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.

### **3.10 CONDUIT SUPPORTS, INSTALLATION**

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
    - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
    - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, Rawl Plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

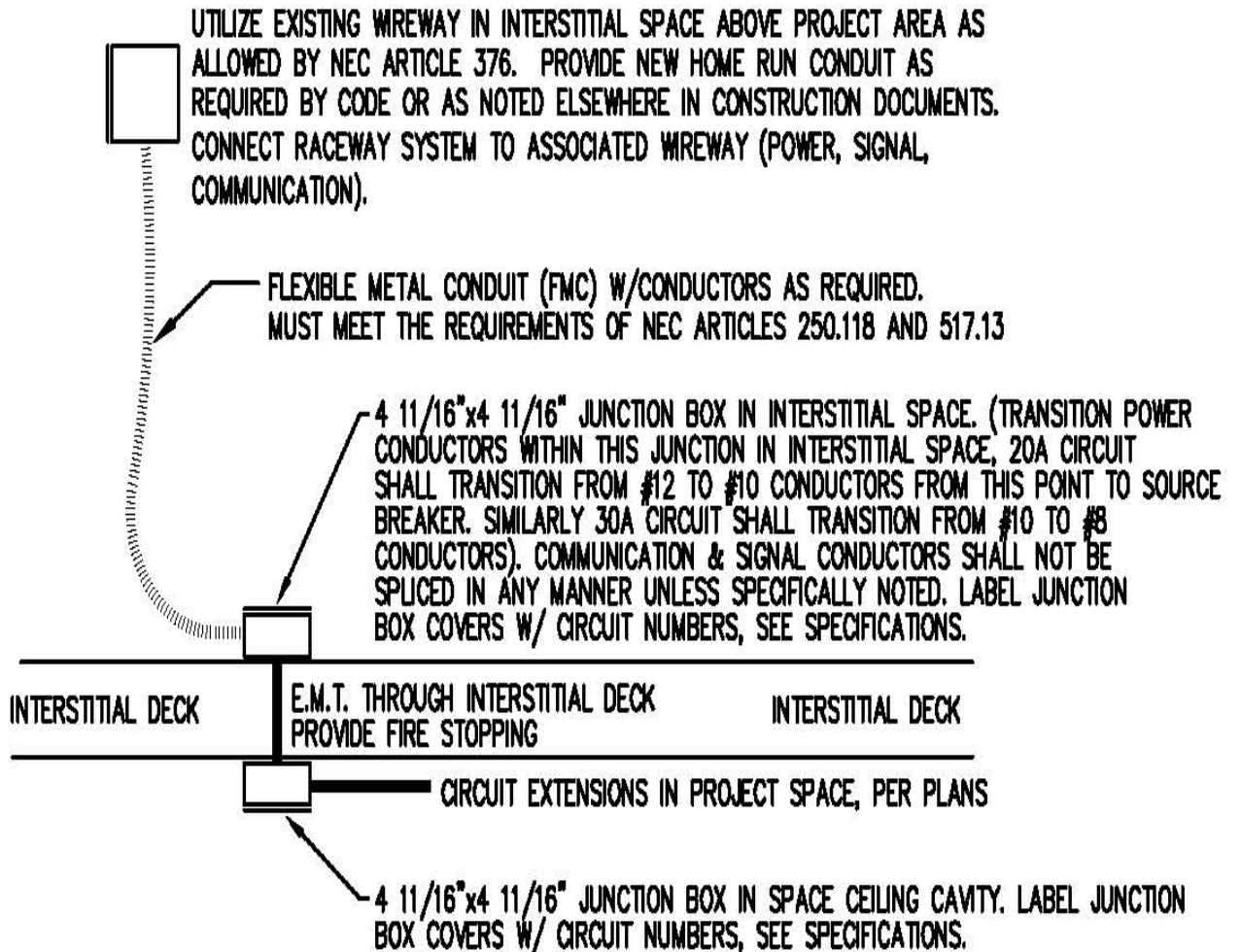
### **3.11 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush mounted.
  - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.
- D. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- E. Outlet boxes in the same wall mounted back-to-back are prohibited.
- F. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- G. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "Sub 4 Bkr #4".
- H. On all Branch Circuit junction box covers, identify the circuits with black marker.

### **3.12 MODULAR FURNITURE FEED (NOT USED)**

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## TYPICAL INTERSTITIAL PENETRATION DETAIL

NO SCALE

POWER SHOWN, SEPECIAL SYSTEMS SIMILAR

IMAGE 3.1.B.1

- - - E N D - - -

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**SECTION 26 05 53**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Floor marking tape and floor clearance markers.

**1.2 RELATED REQUIREMENTS**

- A. Section 09 91 00 - Painting.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (600 Volts and Below): Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- C. Section 26 27 26 - Wiring Devices: Device and wall plate finishes; factory pre-marked wall plates.

**1.3 REFERENCE STANDARDS**

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2009.

**1.4 SUBMITTALS**

- A. See Section 01 33 23 - Shop Drawings, Product Data, and Samples.
- B. Submit all product data and samples concurrently.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for:
  - 1. Cable and Wire Markers.
  - 2. Voltage Markers, indicate size and text height.
  - 3. Floor Markings.
- D. Samples:
  - 1. Identification Nameplates: One of each type and color specified.
  - 2. Identification Labels: One of each type and color specified.
  - 3. Cable and Wire Markers.

## **PART 2 - PRODUCTS**

### **2.1 IDENTIFICATION REQUIREMENTS**

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
  - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    - a. Panelboards:
      - 1) Equipment identification nameplate:
        - (a) Include equipment identification name.
        - (b) Include voltage and phase.
        - (c) Include ampere interrupting capacity (AIC) or short circuit current rating (SCCR).
        - (d) Include power source and circuit number. Include location when not within sight of equipment.
      - 2) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
      - 3) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Circuit directory shall be installed in the appropriate panelboard sleeve. Identify spares and spaces.
      - 4) For power distribution panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
      - 5) For disconnecting means, use identification nameplate to indicate description and power source; i.e.  
STEAM PRESS AGITATOR 402-7-6A9  
SOURCE MCC-7A6
      - 6) Use identification label inside door of fusible switch assemblies to identify fuse class installed.
      - 7) Field Painting: Provide field painting to match existing Government installations. In 1" block lettering, paint the panelboard system voltage, configuration, and feeder

conductor sizes in black or red respective to normal or emergency power. This shall be on the outside of the cover.

(a) Exceptions: do not use the term "EMERGENCY". Use terms:  
"EMERGENCY - LIFE SAFETY"; and  
"EMERGENCY - CRITICAL"

2. Emergency System Equipment:

- a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
- b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.

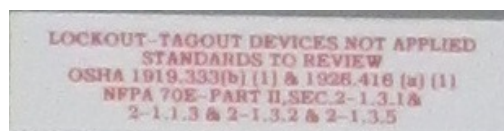
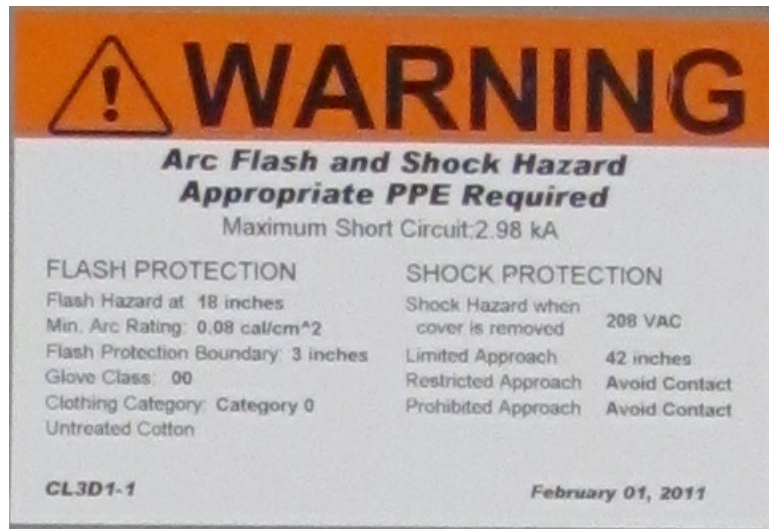
3. Fire Alarm Equipment:

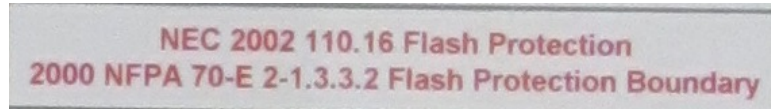
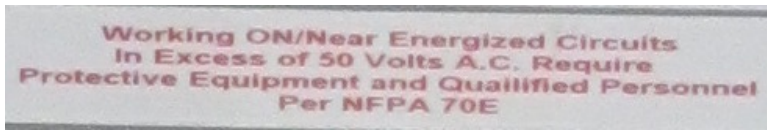
- a. Comply with Section 28 31 00 Fire Detection and Alarm.
- b. Use identification nameplate to identify fire alarm control equipment.
- c. Use identification nameplate to identify fire alarm power supplies.
- d. Include equipment identification name.
- e. Include power source and circuit number. Include location.

4. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as panelboards, and industrial control panels that are likely to require examination, adjustment, servicing, or maintenance while energized.

- a. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data:
  - 1) Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.  
(a) Include the text "Arc Flash and Shock Hazard;  
Appropriate PPE Required" beneath header.
  - 2) Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.  
(a) Include the text "NO SAFE PPE EXISTS ENERGIZED WORK  
PROHIBITED" beneath header.
  - 3) Include the following information:

- (a) Available fault current: Initial RMS 3 Phase bolted fault.
    - (1) Worst case scenario (High Isc).
  - (b) Arc flash protection boundary.
  - (c) Incident energy: Minimum arc rating.
  - (d) Hazard/risk category.
  - (e) PPE (personnel protective equipment) requirements.
  - (f) Nominal voltage.
  - (g) Shock hazard boundaries:
    - (1) Limited approach boundary.
    - (2) Restricted approach boundary.
    - (3) Prohibited approach boundary.
  - (h) Equipment identification.
  - (i) Date calculations were performed.
- b. At locations where a new panel replaces an existing panel; existing feeder and source remains in original state: Populate values on labels to match existing label.
- c. Images of Existing Labels:





5. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers (starters), fused and non-fused safety switches, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 21.
  2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
  3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
    - a. At each source and load connection.
    - b. Within boxes.
- D. Identification for Conduit:
1. Definitions:
    - a. Accessible spaces: Spaces above accessible ceiling tile, spaces with access panels, accessible void spaces, accessible attic spaces.
    - b. Finished spaces: Normally occupied spaces that are not defined as unfinished spaces.
    - c. Unfinished spaces: Mechanical rooms, shop spaces, bulk storage, shell space for future construction.

- d. Concealed: Not visible from within a finished space.
- e. Exposed: Surface installed, visible.
- 2. Use color-coded conduits to identify different systems.
  - a. Fire alarm system: RED
  - b. BAS: GREEN
  - c. 13,800 volt electrical: ORANGE
- 3. Use identification labels or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
- E. Identification for Boxes:
  - 1. Use voltage markers to identify highest voltage present.
  - 2. Use identification labels to identify circuits enclosed.
- F. Identification for Devices:
  - 1. Use identification label to identify fire alarm devices. Comply with Section 28 31 00 Fire Detection and Alarm.
  - 2. Wiring Device and Wall plate Finishes: Comply with Section 26 27 26.
  - 3. Use identification label to identify fire alarm system devices.
  - 4. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.
- G. Identification for Luminaires: Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.
- H. Identification for lighting circuit load transfer switches:
  - 1. Lighting system load transfer switches automatically transfer selected lights from normal to life safety or critical branches of the essential electrical system when the devices sense loss of normal power. These load transfer switches also bypass local switching when the device senses loss of normal power.
  - 2. Provide identification labels on transfer devices to indicate "THIS DEVICE IS CONNECTED TO MORE THAN ONE SOURCE. NORMAL: PANELBOARD \_\_\_\_\_ EMERGENCY: \_\_\_\_\_." Identify warning label with normal and emergency panelboard and circuit information.

## **2.2 IDENTIFICATION NAMEPLATES AND LABELS**

- A. Identification Nameplates:
  - 1. Materials:
    - a. Indoor Clean, Dry Locations: Use plastic nameplates.
    - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.



2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
  3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
  4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
  5. Text height: 3/16 inches minimum.
  6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
  2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
  2. Legend:
    - a. System designation where applicable:
    - b. Equipment designation or other approved description.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height:
    - a. System Designation: 1 inch.
    - b. Equipment Designation: 1/2 inch.
  5. Color:
    - a. Normal Power System: White text on black background.
    - b. Emergency Power System:
      - 1) Life Safety Branch: White text on red background.
      - 2) Critical Branch: White text on red background.
      - 3) Equipment Branch: White text on red background.
    - c. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
  2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height: 1/4 inch.
  5. Color: Black text on white background unless otherwise indicated.
- E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
  2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 1/2 inch.
  5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Receptacle Identification:
1. Minimum Size: 1/4 inch by 1.5 inches.
  2. Legend: Power source and circuit number and/or other designation indicated.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 3/16 inch.
  5. Colors: Refer to Section 26 27 26 WIRING DEVICES.
- G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
  2. Legend: Load controlled and/or other designation indicated.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 3/16 inch.
  5. Color: Refer to Section 26 27 26 WIRING DEVICES.

### **2.3 WIRE AND CABLE MARKERS**

- A. Markers for Branch Circuit Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Feeder Conductors and Cables: Use metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.

- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

#### **2.4 VOLTAGE MARKERS**

- A. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- B. Minimum Size:
  - 1. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
  - 2. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- C. Legend:
  - 1. Markers for Voltage Identification: Highest voltage present.
  - 2. Markers for System Identification:
    - a. Emergency System - Life Safety Branch: Text "LIFE SAFETY".
    - b. Emergency System - Critical Branch: Text "CRITICAL".
    - c. Equipment System: Text "EQUIPMENT".
- D. Color: Black text on orange background unless otherwise indicated.

#### **2.5 FLOOR MARKINGS: NOT USED.**

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

#### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
  - 1. Surface-Mounted Equipment: Enclosure front.
  - 2. Flush-Mounted Equipment: Inside of equipment door.
  - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  - 4. Elevated Equipment: Legible from the floor or working platform.
  - 5. Branch Devices: Adjacent to device.
  - 6. Interior Components: Legible from the point of access.
  - 7. Boxes: Outside face of cover.
  - 8. Conductors and Cables: Legible from the point of access.
  - 9. Devices: Outside face of cover.

- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using stainless steel screws.
  - 1. Do not use adhesives except where substrate cannot be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install arc flash hazard warning labels on electrical equipment.
  - 1. Panelboards with a door: Install on inside surface of door.
  - 2. Power distribution panels with a door: Install inside panel near mains, visible with door open.

### **3.3 FIELD QUALITY CONTROL**

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

- - - END - - -

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100% CD Issue  
03-30-2015

**SECTION 26 05 73**  
**OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the overcurrent protective device coordination study, indicated as the study in this section.
- B. A short-circuit and selective coordination study shall be prepared for the electrical overcurrent devices to be installed under this project.
- C. The study shall present a well-coordinated time-current analysis of each overcurrent protective device from the added panelboard up to the utility source.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. The study shall be prepared by the equipment manufacturer.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Product data on the software program to be used for the study.  
Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings. Existing Arc Flash/Coordination Study for the Mpls VA Health Care System was conducted using SKM Powertools.
  - 2. Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections.
  - 3. Certifications: Two weeks prior to final inspection, submit the following.
    - a. Certification by the Contractor that the overcurrent protective devices have been set in accordance with the approved study.

### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Institute of Electrical and Electronics Engineers (IEEE):
- 242-01.....Protection and Coordination of Industrial and Commercial Power Systems
  - 399-97.....Industrial and Commercial Power Systems Analysis
  - 1584a-04.....Guide for Performing Arc-Flash Hazard Calculations

### 1.6 STUDY REQUIREMENTS

- A. The study shall include one line diagram, short-circuit and ground fault analysis, and protective coordination plots for all overcurrent protective devices.
- B. One Line Diagram:
- 1. Show all electrical equipment and wiring to be protected by the overcurrent devices.
  - 2. Show the following specific information:
    - a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
    - b. Relay, circuit breaker, and fuse ratings.
    - c. Generator kW/kVA and transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
    - d. Voltage at each bus.
    - e. Identification of each bus, matching the identification on the drawings.
    - f. Conduit, conductor, and busway material, size, length, and X/R ratios.
- C. Short-Circuit Study:
- 1. The study shall be performed using computer software designed for this purpose. Pertinent data and the rationale employed in developing the calculations shall be described in the introductory remarks of the study.
  - 2. Calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate

- applicable motor and/or generator contribution in determining the momentary and interrupting ratings of the overcurrent protective devices.
3. Present the results of the short-circuit study in a table. Include the following:
    - a. Device identification.
    - b. Operating voltage.
    - c. Overcurrent protective device type and rating.
    - d. Calculated short-circuit current.
- D. Coordination Curves:
1. Prepare the coordination curves to determine the required settings of overcurrent protective devices to demonstrate selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between devices, including the utility company upstream device if applicable. Plot the specific time-current characteristics of each overcurrent protective device in such a manner that all devices are clearly depicted.
  2. The following specific information shall also be shown on the coordination curves:
    - a. Device identification.
    - b. Potential transformer and current transformer ratios.
    - c. Three-phase and single-phase ANSI damage points or curves for each cable, transformer, or generator.
    - d. Applicable circuit breaker or protective relay characteristic curves.
    - e. No-damage, melting, and clearing curves for fuses.
    - f. Transformer in-rush points.
  3. Develop a table to summarize the settings selected for the overcurrent protective devices. Include the following in the table:
    - a. Device identification.
    - b. Protective relay or circuit breaker potential and current transformer ratios, sensor rating, and available and suggested pickup and delay settings for each available trip characteristic.
    - c. Fuse rating and type.



**1.7 ANALYSIS**

- A. Analyze the short-circuit calculations, and highlight any equipment determined to be underrated as specified. Propose solutions to effectively protect the underrated equipment.

**1.8 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS**

- A. Final field settings and minor modifications of the overcurrent protective devices shall be made to conform with the study, without additional cost to the Government.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

---END---

**SECTION 26 09 23**  
**LIGHTING CONTROLS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation and connection of the lighting controls.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 24 26 16, PANELBOARDS: panelboard enclosure and interior bussing used for lighting control panels.
- E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Product Data: For each type of lighting control, submit the following information.
  - 1. Manufacturer's catalog data.
  - 2. Wiring schematic and connection diagram.
  - 3. Installation details.
- C. Manuals:
  - 1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
  - 2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the COR.
- D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the COR:
  - a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

#### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Green Seal (GS):  
GC-12.....Occupancy Sensors
- C. Illuminating Engineering Society of North America (IESNA):  
IESNA LM-48.....Guide for Calibration of Photoelectric Control Devices
- D. National Electrical Manufacturer's Association (NEMA)  
C136.10.....American National Standard for Roadway Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing  
ICS-1.....Standard for Industrial Control and Systems General Requirements  
ICS-2.....Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment  
ICS-6.....Standard for Industrial Controls and Systems Enclosures
- E. Underwriters Laboratories, Inc. (UL):  
20.....Standard for General-Use Snap Switches  
773.....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting  
773A .....Nonindustrial Photoelectric Switches for Lighting Control  
98.....Enclosed and Dead-Front Switches  
917.....Clock Operated Switches

**PART 2 - PRODUCTS**

**2.1 ELECTRONIC TIME SWITCHES (NOT USED)**

**2.2 ELECTROMECHANICAL-DIAL TIME SWITCHES (NOT USED)**

**2.3 OUTDOOR PHOTOELECTRIC SWITCHES (NOT USED)**

**2.4 TIMER SWITCHES (NOT USED)**

**2.5 CEILING-MOUNTED PHOTOELECTRIC SWITCHES (NOT USED)**

**2.6 SKYLIGHT PHOTOELECTRIC SENSORS (NOT USED)**

**2.7 INDOOR OCCUPANCY SENSORS**

- A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.
  - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
  - 2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
  - 3. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
  - 4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  - 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  - 6. Bypass Switch: Override the on function in case of sensor failure.
  - 7. Manual/automatic selector switch.
  - 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc [21.5 to 2152 lx]; keep lighting off when selected lighting level is present.
  - 9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
- B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.
  - 1. Sensitivity Adjustment: Separate for each sensing technology.
  - 2. Detector Sensitivity: Detect occurrences of 6-inch [150mm] minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. [232 sq. cm], and detect a person of average size and weight moving not less than 12 inches [305 mm] in either a

horizontal or a vertical manner at an approximate speed of 12 inches/s [305 mm/s].

3. Detection Coverage: as scheduled on drawings.

## **2.8 OUTDOOR MOTION SENSOR (PIR) (NOT USED)**

## **2.9 MODULAR DIMMING CONTROLS**

A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. Lutron

B. General System Requirements:

1. Provide system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
2. Architectural Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) and 90 percent non-condensing relative humidity.
3. Designed and tested to withstand electrostatic discharges up to 15,000 V without impairment per IEC 801-2.
4. Wireless Devices shall:
  - a. Have addresses automatically assigned to them.
  - b. Receive signals from other wireless devices and provide feedback to user.
  - c. Work in conjunction with wireless wireless controllers.

C. Dimming Performance Requirements:

1. Electrolytic capacitors to operate at least 20 degrees C below the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40 degrees C (104 degrees F) ambient temperature.
2. Load Handling Thyristors (SCRs and triacs), Field Effect Transistors (FETs), and Isolated Gate Bipolar Transistors (IGBTs): Manufacturer's maximum current rating minimum two times control's rated operating current.
3. Capable of withstanding repetitive inrush current of 50 times operating current without impacting lifetime of dimmer.
4. Design and test dimmers to withstand line-side surges without impairment to performance.
  - a. Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41.

- b. Other power handling devices: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 200 amps per ANSI/IEEE C62.41.
- 5. Utilize air gap off - activated when user selects "off" at any control to disconnect the load from line supply.
- 6. Power failure memory and dimmer/relay recovery:
  - a. When power is interrupted and subsequently returned, within 3 seconds lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption.
- 7. Multiple load type, tested to UL 508 to specifically control incandescent/tungsten, magnetic low voltage, electronic low voltage, LED, neon/cold cathode, digital fluorescent dimming ballasts, fluorescent dimming ballasts, and non-dim loads...
- 8. Each dimmer to be assigned a load type that will provide a proper dimming curve for the specific light source.
- 9. Possess ability to have load types assigned per circuit, configured in field.
- 10. Minimum and maximum light levels user adjustable on circuit-by-circuit basis.
- 11. Control all light sources in smooth and continuous manor. Dimmers with visible steps are not acceptable.
- 12. Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage/cycle), frequency shifts (plus or minus 2 Hz change in frequency/second), dynamic harmonics, and line noise. Systems not providing cycle-by-cycle compensation to include external power conditioning equipment to meet these requirements.
- 13. Systems not providing cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
- 14. Each dimmer to incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.
- 15. Direct low-voltage control of digital ballasts (120V, 220/240V, and/or 277V lighting):
  - a. Electronically link a digital fluorescent lighting ballast to a zone for both dimming and turn on/off
  - b. Energy usage and light level status visible to operator on an integral display

- c. Electronically assign occupancy sensors for manual on/auto off and auto on/auto off
- d. Electronically assign daylight sensors to digital ballasts and line voltage dimmers for proportional daylight harvesting
- e. Single integral controller with Class 1 or Class 2 isolated digital output signal conforming to IEC 60929; capable of direct (no-interface) control.]

D. Wallstations:

1. Line Voltage Control Unit

a. Product: Grafik Eye QS

- i. Preset lighting control with zone override:
- ii. Intensity for each zone indicated by means of one illuminated bar graph per zone.
- iii. Each zone and scene to be field customizable to indicate each zone and scene name.
- iv. Astronomical time clock and programmer interface to provide access to:
  - a. Scene selections
  - b. Fade zone to a level
  - c. Fine-tuning of preset levels with scene raise/lower.
  - d. Lock out scenes and zones.
  - e. Fine-tuning of light levels with individual zone raise/lower.
  - f. Terminal block for wired infrared receiver.
  - g. For temporary local overrides, individual raise/lower buttons to allow zones to be adjusted without altering scene values stored in memory.
  - h. Direct low voltage control of digital ballasts/power supplies (120, and/or 277V lighting).

b. Color

- i. Clear Anodized Aluminum Finish.
- ii. Black Buttons.
- iii. Visible Parts:
  - a. Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ATSM D4674. Provide proof of testing upon request.

2. Architectural Low Voltage Wall Stations:

a. Product: seeTouch QS

b. Electronics:

- i. Use RS485 wiring for low voltage communication.
- c. Functionality:
  - i. LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or the LEDs turn off if the button press was not processed.
  - ii. Allow for easy reprogramming without replacement of the unit.
- d. Provide faceplates with concealed mounting hardware.
- e. Color
  - i. Clear Anodized Aluminum Finish.
  - ii. Black Buttons.
  - iii. Visible Parts:
    - a. Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ATSM D4674. Provide proof of testing upon request.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION:**

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
- B. Set occupancy sensor "on" duration to 15 minutes.
- C. Startup and programming of modular dimming controls.
  - 1. With phone startup completion and End User Registration, the 1-year parts-only warranty will be upgraded to the Standard 2-year Warranty. Provide factory-certified field service engineer to a site visit to ensure proper system installation and operation under following parameters:
  - 2. Qualifications for factory-certified field service engineer:
    - a. Minimum experience of 2 years training in the electrical/electronic field.
    - b. Certified by the equipment manufacturer on the system installed.



3. Scene Settings:

a. Scene 1:

- i. Zone 1 - 50% On
- ii. Zone 2 - 75% On
- iii. Zone 3 - 50% On
- iv. Zone 4 - 50% On
- v. Zone 5 - 100% On
- vi. Zone 6 - Off

b. Scene 2:

- i. Zone 1 - 50% On
- ii. Zone 2 - 75% On
- iii. Zone 3 - 50% On
- iv. Zone 4 - 50% On
- v. Zone 5 - 50% On
- vi. Zone 6 - 100% On

c. Scene 3:

- i. Zone 2 - 100% On.
- ii. All other zones retain previous state.

d. Scene 4:

- i. Zone 3 - 100% On.
- ii. All other zones retain previous state.

4. Make a visit upon completion of installation of modular dimming control system:

- a. Verify connection of power feeds and load circuits.
- b. Verify connection and location of controls.
- c. Program system data.
- d. Verify proper connection of digital control link.
- e. Verify proper operation of manufacturers interfacing equipment.
- f. Obtain sign-off on system functions.
- g. User to be trained on system operation.

5. Tech Support

- a. Provide factory direct technical support hotline 24 hours per day, 7 days per week.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations.
- B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.
- C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.
- D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

### **3.3 FOLLOW-UP VERIFICATION**

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function.

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PROJECT NO. 618-CSI-100  
Renovate to Create Hybrid OR, Phase 2  
100% CD Issue  
03-30-2015

**SECTION 26 20 11**  
**ISOLATED POWER SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of isolated power systems.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
  - 1. Sufficient information shall be clearly presented to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, weights, mounting details, front view, side view, equipment and device arrangement, branch circuit overcurrent protection, wiring diagrams, materials, and connection diagrams.
- C. Manuals: Two weeks prior to the final inspection, submit four copies of the following to the COR:
  - 1. Complete maintenance, operating and testing manuals, including wiring diagrams, technical data sheets, and information for ordering replaceable parts:

- a. Include complete "As Installed" diagrams that indicate all items of equipment and their interconnecting wiring.
  - b. Include complete diagrams of the internal wiring for each of the items of equipment, including "As Installed" revisions of the diagrams.
  - c. The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
- D. Certifications: Two weeks prior to the final inspection, submit four copies of the following to the COR:
- 1. Certification by the manufacturer that the equipment conforms to the requirements of the drawings and specifications.
  - 2. Certification by the isolated electrical power system equipment manufacturer that the isolating transformers have been tested and conform to the leakage current and sound level requirements specified.
  - 3. Certification by the contractor that the equipment has been properly installed, adjusted, and tested.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
  - 99-05.....Health Care Facilities
- C. Underwriters Laboratories, Inc. (UL):
  - 6-07.....Electrical Rigid Metal Conduit-Steel
  - 50-95.....Enclosures for Electrical Equipment
  - 797-07.....Electrical Metallic Tubing-Steel
  - 1022-98.....Line Isolation Monitors
  - 1047-03.....Isolated Power Systems Equipment

### **PART 2 - PRODUCTS**

#### **2.1 EQUIPMENT**

- A. Manufacturer: PG Life Link
  - 1. Substitutions: Not Permitted.
- B. Isolated power systems shall be complete as shown on the drawings and include unitized isolated power units (IPUs), their associated remote

outlets, power receptacles, grounding receptacles, equipotential ground bus modules with power and grounding receptacles, line isolation monitors, and related circuitry.

- C. The isolated power systems shall be in accordance with NFPA 99 and UL 50, 1022, and 1047. Isolated Power system panels shall be Post Glover, Mark V series to match existing type. Panels shall be 5 kVA in size unless noted otherwise, single-section.
- D. Incorporate the IPU's in factory-assembled units as shown on the detail drawings. House the isolation transformer, line isolation monitor, and circuit breaker panel board in each IPU unit.
- E. Line isolation monitors shall be in accordance with the following:
  - 1. Article, "Line Isolation Monitor," in NFPA 99.
  - 2. Dynamic-type, capable of detecting any combination of resistive and/or capacitive faults, including balanced, unbalanced, and hybrid faults.
  - 3. Incorporate in each line isolation monitor, or on the front trim of the panel, a hazard meter or digital display, indicator lights, a buzzer with a local momentary-contact silencing switch or push-button, a test switch, and provisions for transmitting the alarm signals to a remote location. The hazard meter and indicator lights shall be conspicuously visible on the exterior face of the IPU. Transmission of the alarm signals to remote locations up to several hundred feet from the monitor shall not unduly increase the leakage current for the system.
- F. Isolating transformers shall be in accordance with the following:
  - 1. Single phase with primary and secondary voltages as indicated on the drawings. These ratings are for continuous duty without the use of cooling fans.
  - 2. Self-cooled by natural convection, dry, isolating windings, conventional (stacked design) type, with an electrostatic shield grounded between the primary and secondary windings, in accordance with NFPA 99.
  - 3. Maximum temperature rises of materials and components shall not exceed the values listed in Table 29.1 of UL 1047.
  - 4. Cores shall be grain-oriented silicon steel.
  - 5. Leakage current between each winding and ground shall be in compliance with UL 1047, Table 30.1, and Table 30.2.
  - 6. Sound levels shall not exceed the following in accordance with NEMA Standards:
    - a. 5 kVA transformers or fewer: 28 dB.

- b. 7.5 kVA transformers: 32 dB.
- c. Larger transformers: 35 dB.
- 7. Temperature rise shall be limited 176 ° F [80° C] above ambient temperature.
- 8. Each nameplate shall include the wiring diagram, leakage current, and sound level.
- 9. Install the transformers with adequate provisions for removal of the heat they produce.
- 10. Install the transformers so the sound levels shall not exceed the factory test sound levels for the same transformers.
- G. Circuit breaker panels shall be in accordance with the following:
  - 1. Circuit breaker-equipped, dead-front, with protection for the breaker handles.
  - 2. Bus bars:
    - a. Shall be copper with silver-plated joints.
    - b. Panel to include ground bus.
  - 3. Only the handles of the breakers shall be accessible.
  - 4. Molded Case Circuit Breakers:
    - a. Dimensions of the breakers shall be small enough so all of the components can be satisfactorily incorporated within the cabinets.
    - b. A rugged, integral housing of molded insulating material.
    - c. Silver alloy contacts.
    - d. Arc quenchers and phase barriers for each pole.
    - e. Quick-make, quick-break, operating mechanisms.
    - f. A trip element for each pole, a common trip bar for all poles, and molded insulating material handle.
    - g. Electrically and mechanically trip-free.
    - h. Indicating operating handle showing the ON, TRIPPED, and OFF positions.
  - 5. Print typewritten circuit information on the directory cards, insert them into metal holders with non-flammable transparent covers, and mount the holders on the inside of the cabinet covers. Adequately identify each circuit.
- H. Power Receptacles:
  - 1. UL-listed.
  - 2. Non-hazardous areas; hospital grade, NEMA 5-20R unless otherwise indicated.
- I. Remote Ground Indicator Panel shall be in accordance with the following:
  - 1. Monitor all of the isolated type electrical power systems as shown on the drawings.

2. Include a set of red and green indicator lights and a buzzer with a local, momentary-contact silencing switch or push-button for each of the isolated-type electrical power systems monitored by the panel. All of the items shall operate in the same manner as the corresponding items at the line isolation monitor for the same isolated type electrical power system.
3. Stainless steel or anodized aluminum faceplates.
- J. Clearly identify individual devices on the faceplates of all equipment. Method of identification shall be permanent such the labels will not be effected by the use of hospital-type cleaning materials.
- K. All equipment shall be flush-mounted as shown on the drawings.
- L. Use stainless steel for exposed faceplate surfaces of isolated power systems equipment in operating rooms.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with manufacturer's recommendations, NFPA, NEC, and as shown on the drawings.
- B. Branch circuits that are energized by the isolated type electrical power system shall conform to the following requirements:
  1. Article "Impedance of Isolated Wiring," in NFPA 99.
  2. Shall not be grounded, but rather protected by circuit breakers with one pole for each conductor in the circuit.
  3. Applicable paragraphs in specification Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
  4. Branch circuits shall be as short as practicable to minimize the leakage currents.
  5. Connect all of the receptacles for each of the systems such that identical poles in all of the receptacles are connected to the same terminal of the isolating transformer.
  6. Install the branch circuit wiring in rigid steel conduit or electrical metallic tubing. Do not use wire lubricating compound on branch circuits connected to the isolated power system.

#### **3.2 FIELD TESTING**

- A. Once the equipment and all of the interconnecting circuits have been completely installed prior to the final inspection, provide testing equipment and perform the following tests, in the presence of the COR, to indicate that the systems operate properly in every respect.



1. Test to verify that all of the wiring is properly connected and clear of ground faults, shorts, and open circuit defects.
  2. Test to verify that all of the equipment is operating properly.
  3. Tests:
    - a. Make a calibration test on each of the micro-ammeters. The tests shall be accurate within 3%.
    - b. With all of the circuit breakers closed and without any equipment plugged into the receptacles, read and record the inherent total leakage current indicated by the micro-ammeter. The leakage currents shall be small enough to indicate that all of the equipment and circuit installations are satisfactory for proper operation of the equipment. Submit four copies of the certified data sheets of the test.
    - c. With an electrical test, demonstrate that identical poles of all of the power receptacles for each of the isolated-type electrical power systems are connected to the same terminal of the isolating transformer.
    - d. With an electrical test, demonstrate that either terminal of each of the isolating transformers, when shorted to ground in one of the power receptacles, will actuate the ground alarm without causing the circuit breaker to trip.
    - e. Connect not fewer than eight pieces of equipment successively to the power receptacles for each of the isolated-type electrical power systems. As each item is connected, read and record the total leakage current indicated by the micro-ammeter. Each of the readings should be larger than the preceding reading.
    - f. In addition, perform all manufacturer's recommended test procedures of the Isolated Power System to supplement the above tests.
    - g. Furnish a portable, precision laboratory quality test box suitable for making the above tests that includes a multi-position rotary switch with appropriate resistors and a cord with a plug. Test box shall be transferred to the COR upon satisfactory completion of all tests.
  4. When any defects are detected, make repairs or install replacement components and repeat the tests as requested by the COR.
- B. At the final inspection, demonstrate that the isolated electrical power systems operate properly in the presence of the COR.

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**SECTION 26 24 16**  
**PANELBOARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of panelboards.

**1.2 RELATED WORK**

- A. Section 09 91 00, PAINTING: Painting of panelboards.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:  
Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:  
Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:  
Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- F. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY:  
Short circuit and coordination study, and requirements for a coordinated electrical system.
- G. Section 26 09 23, LIGHTING CONTROLS: Lighting controls integral to panelboards.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
  2. Manuals:
    - a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data

sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.

- 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
- 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that the panelboards have been properly installed, adjusted, and tested.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):  
IBC-12.....International Building Code
- C. National Electrical Manufacturers Association (NEMA):  
PB 1-11.....Panelboards  
250-08.....Enclosures for Electrical Equipment (1,000V  
Maximum)
- D. National Fire Protection Association (NFPA):  
70-14.....National Electrical Code (NEC)  
70E-12.....Standard for Electrical Safety in the Workplace
- E. Underwriters Laboratories, Inc. (UL):  
50-95.....Enclosures for Electrical Equipment  
67-09.....Panelboards  
489-09.....Molded Case Circuit Breakers and Circuit  
Breaker Enclosures

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Manufacturer: Eaton Cutler Hammer
  - 1. Substitutions: Not permitted.
- B. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.
- C. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- D. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- E. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- F. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
- G. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
- H. Neutral bus shall be 200%, mounted on insulated supports.
- I. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- J. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.
- K. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with sub-feed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have field-installed cable connections to the second section as shown on the drawings. Panelboard sections with tapped bus or crossover bus are not acceptable.
- L. Series-rated panelboards are not permitted.
- M. Install Arc-Flash Hazard Warning labeling as required by NEC. Include the Flash Protection Boundary and Flash Hazard Category.

### **2.2 ENCLOSURES AND TRIMS**

- A. Enclosures:

1. Provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
2. Enclosures shall not have ventilating openings.
3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
4. Manufacturer's standard option for pre-punched knockouts on top and bottom end walls shall NOT be used.
5. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:

1. Hinged "door-in-door" type.
2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
4. Inner and outer doors shall open left to right.
5. Trims shall be flush or surface type as shown on the drawings.

**2.3 MOLDED CASE CIRCUIT BREAKERS**

- A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.
- B. Circuit breakers shall be bolt-on type.
- C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
  1. 120/208 V Panelboard: 10,000 A symmetrical.
  2. 120/240 V Panelboard: 10,000 A symmetrical.
  3. 277/480 V Panelboard: 14,000 A symmetrical.
- D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400A frame.
- E. Circuit breaker features shall be as follows:
  1. A rugged, integral housing of molded insulating material.
  2. Silver alloy contacts.
  3. Arc quenchers and phase barriers for each pole.
  4. Quick-make, quick-break, operating mechanisms.

5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates closed, tripped, and open positions.
8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.
10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

#### **2.4 SURGE PROTECTIVE DEVICES (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. New panelboards installed where it serves an area with an interstitial space shall include the installation of a conduit rack as specified in Image 3.1.C at the end of this specification.
  1. Conduit racks are not required for Isolation Power Panels.
- D. Install a printed schedule of circuits in each panelboard after approval by the COR. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboard sleeve.
- E. Provide blank cover for each unused circuit breaker mounting space.

#### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  1. Visual Inspection and Tests:
    - a. Compare equipment nameplate data with specifications and approved shop drawings.

- b. Inspect physical, electrical, and mechanical condition.
- c. Verify appropriate anchorage and required area clearances.
- d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
- e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
- f. Vacuum-clean enclosure interior. Clean enclosure exterior.

### **3.3 FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

---END---

**SECTION 26 27 26**

**WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit 4 hard copies and one digital copy of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
  - 2. Manuals:
    - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.



- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 3. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Fire Protection Association (NFPA):
  - 70-14.....National Electrical Code (NEC)
  - 99-12.....Health Care Facilities
- C. National Electrical Manufacturers Association (NEMA):
  - WD 1-10.....General Color Requirements for Wiring Devices
  - WD 6-08 .....Wiring Devices - Dimensional Specifications
- D. Underwriter's Laboratories, Inc. (UL):
  - 5-11.....Surface Metal Raceways and Fittings
  - 20-10.....General-Use Snap Switches
  - 231-07.....Power Outlets
  - 467-07.....Grounding and Bonding Equipment
  - 498-07.....Attachment Plugs and Receptacles
  - 943-11.....Ground-Fault Circuit-Interrupters
  - 1449-07.....Surge Protective Devices
  - 1472-96.....Solid State Dimming Controls

### **PART 2 - PRODUCTS**

#### **2.1 RECEPTACLES**

- A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.
  - 1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.

2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
  3. All receptacles, new or existing, located in the Project Area shall be labeled with the panel and circuit number in a manner specified by the COR.
- B. Duplex Receptacles: Hospital-grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.
1. Bodies shall be ivory in color for normal power and red in color for emergency power.
  2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
  3. Duplex Receptacles on Emergency Circuit: In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
  4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring. Ground fault interrupter shall consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.

## **2.2 TOGGLE AND ROCKER SWITCHES**

- A. Rocker switches are to be used throughout the campus unless otherwise noted. They shall meet the minimum specifications as toggle switches below.
- B. Toggle switches, where used, shall be totally enclosed tumbler type with nylon bodies. Handles shall be ivory in color unless otherwise specified or shown on the drawings.
1. Switches installed in hazardous areas shall be explosion-proof type in accordance with the NEC and as shown on the drawings.

2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plaster ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
3. Switches shall be rated 20 amperes at 120-277 Volts AC.

### **2.3 MANUAL DIMMING CONTROL**

- A. Electronic full-wave manual slide dimmer with on/off switch and audible frequency and EMI/RFI suppression filters.
- B. Manual dimming controls shall be fully compatible with LED power supplies and approved by the power supply manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the power supply or lamp.
- C. Provide single-pole or three-way, as shown on the drawings.

### **2.4 WALL PLATES**

- A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.
- B. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- C. In areas requiring tamperproof wiring devices, wall plates shall have tamperproof screws and beveled edges.
- D. All Receptacles shall be labeled with a ½" white label with lettering indicating panel and circuit number placed on the plate just above the top of the receptacle. Use black lettering for normal power and red lettering for emergency power.

### **2.5 SURFACE MULTIPLE-OUTLET ASSEMBLIES**

- A. Shall have the following features:
  1. Enclosures: Thickness of steel shall be not less than 1 mm (0.040 inch) for base and cover. Nominal dimensions shall be 40 mm x 70 mm (1½ inches by 2-¾ inches) with inside cross sectional area not less than 2250 square mm (3½ square inches). The enclosures shall be thoroughly cleaned, phosphatized, and painted at the factory with primer and the manufacturer's standard baked enamel finish.
  2. Receptacles shall be duplex, hospital grade. See paragraph 'RECEPTACLES' in this Section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.

3. Conductors shall be as specified in Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE.
4. Installation fittings shall be the manufacturer's standard bends, offsets, device brackets, inside couplings, wire clips, elbows, and other components as required for a complete system.
5. Bond the assemblies to the branch circuit conduit system.

## **2.6 POKE-THRU DEVICES (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Install wiring devices after wall construction and painting is complete.
- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
- D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
- E. Provide barriers in multigang outlet boxes to comply with the NEC.
- F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.
- H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
- I. Install wall dimmers 1.2 M (48 inches) above floor.
- J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- K. Install vertically mounted receptacles with the ground pin down. Install horizontally mounted receptacles with the ground pin to the right.

- L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform manufacturer's required field checks in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests:
    - a. Inspect physical and electrical condition.
    - b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
    - c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
    - d. Test GFCI receptacles.
  - 2. Healthcare Occupancy Tests:
    - a. Test hospital grade receptacles for retention force per NFPA 99.

---END---

**SECTION 26 29 21**  
**DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation and connection of low voltage disconnect switches.

**1.2 RELATED WORK**

- A. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Conduits for cables and wiring: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- C. Cables and wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground faults: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
  - 1. Include sufficient information, clearly presented to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, mounting details, materials, enclosure types, fuse type and class.
  - 3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.
- C. Manuals:
  - 1. Provide complete maintenance and operating manuals for disconnect switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Deliver four copies to the COR two weeks prior to final inspection.
  - 2. Identify terminals on wiring diagrams to facilitate maintenance and operation.
  - 3. Wiring diagrams shall indicate internal wiring and any interlocking.
- D. Certification: Two weeks prior to final inspection, deliver to the COR four copies of the certification that the equipment has been properly installed, adjusted, and tested.

#### 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):
  - KS 1-01.....Enclosed and Miscellaneous Distribution  
Equipment Switches (600 Volts Maximum)
- C. National Fire Protection Association (NFPA):
  - 70-14.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
  - 98-98.....Enclosed and Dead-Front Switches
  - 198C-89.....High-Interrupting-Capacity Fuses, Current  
Limiting Types
  - 198E-94.....Class R Fuses
  - 977-99.....Fused Power-Circuit Devices

#### PART 2 - PRODUCTS

##### 2.1 LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS

- A. Shall be quick-make, quick-break type in accordance with UL 98, NEMA KS 1 and NEC.
- B. Shall have a minimum duty rating, NEMA classification General Duty (GD) for 240 volts and NEMA classification Heavy Duty (HD) for 277/480 volts.
- C. Shall be horsepower rated.
- D. Shall have the following features:
  - 1. Switch mechanism shall be the quick-make, quick-break type.
  - 2. Copper blades, visible in the OFF position.
  - 3. An arc chute for each pole.
  - 4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
  - 5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
  - 6. Fuse holders for the sizes and types of fuses specified.
  - 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
  - 8. Ground Lugs: One for each ground conductor.
  - 9. Enclosures:
    - a. Shall be the NEMA types shown on the drawings for the switches.

- b. Where the types of switch enclosures are not shown, they shall be the NEMA types which are most suitable for the environmental conditions where the switches are being installed. Unless otherwise indicated on the plans, all outdoor switches shall be NEMA 3R.
- c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

## **2.2 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS**

- A. Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, but no fuses.

## **2.3 LOW VOLTAGE FUSIBLE SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES**

- A. Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, except for the minimum duty rating which shall be NEMA classification Heavy Duty (HD). These switches shall also be horsepower rated.

## **2.4 MOTOR RATED TOGGLE SWITCHES**

- A. Refer to Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for motor rated toggle switches.

## **2.5 IDENTIFICATION SIGNS**

- A. Install nameplate identification signs on each disconnect switch to identify the equipment controlled.
- B. Nameplates shall be laminated black phenolic resin with a white core, with engraved lettering, a minimum of 6 mm (1/4-inch) high. Secure nameplates with screws.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Install disconnect switches in accordance with the NEC and as shown on the drawings.
- B. Fusible disconnect switches shall be furnished complete with fuses.

## **3.2 SPARE PARTS**

Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fusible disconnect switch installed on the project. Deliver the spare fuses to the COR.

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PROJECT NO. 618-CSI-100  
Renovate to Create Hybrid OR, Phase 2  
100% CD Issue  
03-30-2015

**SECTION 26 51 00**  
**INTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

A. This section specifies the furnishing, installation and connection of the interior lighting systems.

**1.2 DEFINITIONS**

- A. Emergency Lighting Unit: A fixture with integral emergency battery power supply and the means for controlling and charging the battery.
- B. Fixture: A complete lighting unit, exit sign. Fixtures include lamps and parts required to distribute the light, position and protect the lamps, and connect lamps to the power supply.
- C. Luminaire: Fixture.
- D. Rated Life, LED: The time at with the output of the luminaire is 70 percent of the initial output.

**1.3 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- D. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

**1.4 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.5 SUBMITTALS**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following. Submit Consolidated Table, Shop Drawings, Product Data, and Samples (where required) concurrently:
- B. Format: Provide binder and with tabs, and electronic file with directory structure as follows:
  - 1. Tab 1: Consolidated Table. Include spares for each ballast and lamp type.

2. Tab 2: Shop drawings. Identify by lighting fixture type. Include ballast manufacturer and model number in product identification code.
3. Tab 3: Ballast product data: Submit product data for each ballast used in this project. Identify each ballast by the lighting fixture types the ballast will be used. Do not submit identical ballasts multiple times.
4. Tab 4: Lamp product data: Submit product data for each lamp used in this project. Identify each lamp by the lighting fixture types the lamp will be used. Do not submit identical lamps multiple times.
5. Incomplete submittals, and/or improperly assembled submittals may result in the submittal returned to the Contractor for correction and resubmission. Partial submittals will not be considered for approval. Incomplete or incorrectly prepared submittals may be returned without review.

B. Consolidated Table: Submit luminaire information in table format, including in separate columns: Fixture manufacture name and model number; lamp quantity, manufacturer name and model number; ballast manufacturer name and model number; and ANSI input watts.

1. Electrical supplier bill of material is not an acceptable substitute for Consolidated Table.

2. Sample Consolidated Table:

<b>LUMINAIRES</b>				
<b>LUMINAIRE</b>		<b>LAMP</b>	<b>BALLAST</b>	<b>ANSI</b>
TYPE	MANUFACTURER AND CATALOG NUMBER	MANUFACTURER AND MODEL NUMBER	MANUFACTURER AND MODEL NUMBER	INPUT WATTS
A2	LITHONIA 2SP8-G-232-FW-A12125-MVOLT	PHILLIPS (2)-F32T8/ADV835/ALTO	ADVANCE IOP-2S32-SC	56
H4	SIMKAR ADJUST-454-S12-UNV/AWG4/CAB472	PHILLIPS (4)-F54T5/ADV841HOEA49W/ALTO	ADVANCE IOP-4PSP542-LSG	208

- C. Shop Drawings: For each type of lighting fixture (luminaire) designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of fixture designation, submit the following information:
1. Material and construction details include information on housing, optics system and lens/diffuser.
  2. Physical dimensions and description.
  3. Wiring schematic and connection diagram.
  4. Installation details.
  5. Energy efficiency data.

6. Photometric data based on laboratory tests complying with IESNA Lighting Measurements, testing and calculation guides
- D. Product Data: For each type of LED driver, ballast and lamp provided with lighting fixtures (luminaires) designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of fixture designations, submit the following information.
1. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours) and color temperature (degrees Kelvin). Identify by lighting fixture type(s) for intended use.
  2. LED driver or lamp ballast data including driver manufacturer and type, lamp ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts and total harmonic distortion (THD). Identify by lighting fixture type(s) for intended use.
- E. Manuals:
1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
  2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the COTR.
- F. Certifications: Two weeks prior to final inspection, submit four copies of the following certifications to the COTR, Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):  
C62.41-91.....Guide on the Surge Environment in Low Voltage  
(1000V and less) AC Power Circuits
- C. National Fire Protection Association (NFPA):  
70.....National Electrical Code (NEC)  
101.....Life Safety Code

D. National Electrical Manufacturer's Association (NEMA):

- C82.1-97.....Ballasts for Fluorescent Lamps - Specifications
- C82.2-02.....Method of Measurement of Fluorescent Lamp  
Ballasts
- C82.4-02.....Ballasts for High-Intensity-Discharge and Low-  
Pressure Sodium Lamps
- C82.11-02.....High Frequency Fluorescent Lamp Ballasts

E. Underwriters Laboratories, Inc. (UL):

- 496-96.....Edison-Base Lampholders
- 542-99.....Lampholders, Starters, and Starter Holders for  
Fluorescent Lamps
- 844-95.....Electric Lighting Fixtures for Use in Hazardous  
(Classified) Locations
- 924-95.....Emergency Lighting and Power Equipment
- 935-01.....Fluorescent-Lamp Ballasts
- 1029-94.....High-Intensity-Discharge Lamp Ballasts
- 1029A-06.....Ignitors and Related Auxiliaries for HID Lamp  
Ballasts
- 1598-00.....Luminaires
- 1574-04.....Standard for Track Lighting Systems
- 2108-04.....Standard for Low-Voltage Lighting Systems
- 8750-08.....Light Emitting Diode (LED) Light Sources for  
Use in Lighting Products

F. Federal Communications Commission (FCC):

Code of Federal Regulations (CFR), Title 47, Part 18

**1.7 QUALITY ASSURANCE**

- A. Coordination of Fixtures with Ceiling: Coordinate fixtures mounting hardware and trim with the ceiling system.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

**1.8 EXTRA MATERIALS: NOT USED.**

**PART 2 - PRODUCTS**

**2.1 LIGHTING FIXTURES (LUMINAIRES)**

- A. Manufacturers: As indicated per Lighting Fixture Schedule on Drawings.
  - 1. Substitutions: Refer to Division 1 requirements.
  - 2. Where the term "Approved Equal" is used, substitution request shall be submitted for review during the Bidding Period.
- B. Shall be in accordance with NFPA 70 and UL 1598, as shown on drawings, and as specified.
- C. Sheet Metal:
  - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
  - 2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
  - 3. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
  - 4. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, latches shall function easily by finger action without the use of tools.
- D. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- E. Lamp Sockets: Fluorescent lamp holder contacts shall be the biting edge type or phosphorous-bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542. Lamp holders for bi-pin lamps shall be of the telescoping compression type, or of the single slot entry type requiring a one-quarter turn of the lamp after insertion.
- F. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- G. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive

screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

H. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
2. Interior light reflecting finishes shall be white with not less than 90 percent reflectance, except where otherwise shown on the drawing.
3. Specification Grade: Where indicated "Specification Grade", paint after fabrication.
4. Exterior finishes shall be as shown on the drawings.

I. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

J. Light Transmitting Components for Fluorescent Fixtures:

1. Shall be 100 percent virgin acrylic.
2. Flat lens panels shall have not less than 1/8 inch [3.2mm] of average thickness, or greater thickness where indicated on schedules. The average thickness shall be determined by adding the maximum thickness to the minimum unpenetrated thickness and dividing the sum by 2.
3. Unless otherwise specified, lenses, diffusers and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction of the lens without distortion or cracking.

**2.2 BALLASTS**

- A. All ballasts shall be electronic type unless noted otherwise.
- B. Low Temperature Ballasts: Minus 20 deg C minimum starting temperature.
- C. Conform to UL 935, "Fluorescent-Lamp Ballasts."
  1. Certification: By Electrical Testing Laboratory (ETL).
  2. Labeling: By Certified Ballast Manufacturers Association (CBM).
  3. Sound Rating: A rating, except as indicated otherwise.

4. Voltage: Match connected circuits.
- D. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V)  
electronic, solid-state, complying with UL 935 and with ANSI C 82.11,  
designed for type and quantity of lamps indicated. Ballast shall be  
designed for full light output unless dimmer or bi-level control is  
indicated; including the following features:
  1. Performance: Ballasts for T8 lamps shall be qualifying products  
for High Performance T8 Systems, manufacturer and model number on  
the approved list at Consortium for Energy Efficiency:  
[www.ceel.org](http://www.ceel.org).
  2. Lamp Starting: Programmed start.
    - a. Instant start for low temperature applications.
  3. Minimum Power Factor: 98 percent.
  4. Lamp Wiring: Series wired lamps.
  5. Minimum Operating Frequency: 40-50 kHz, without visible flicker.
  6. Total Harmonic Distortion: Less than 10 percent.
  7. Lamp Current Crest Factor: Less than 1.7.
  8. Lamp end-of-life detection and shutdown circuit (T5 and compact  
fluorescent lamps only).
  9. Automatic lamp starting after lamp replacement.
  10. Sound Rating: Class A.
  11. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2,  
Category A or better.
  12. Interference: Comply with 47 CFT 18, Ch.1, Subpart C, for  
limitations on electromagnetic and radio-frequency interference  
for non-consumer equipment.
  13. To facilitate multi-level lamp switching, lamps within fixture  
shall be wired with the outermost lamp at both sides of the  
fixture on the same ballast, the next inward pair on an additional  
ballast and so on to the innermost lamp (or pair of lamps). Within  
a given room, each switch shall uniformly control the same  
corresponding lamp (or lamp pairs) in all fixture units that are  
being controlled.
  14. Ballast Factor for T8 Lamps: As indicated by ballast type per  
lighting fixture schedule on drawings.
    - a. Programmed start, low ballast factor (PS-LBF): BF=0.71.
    - b. Programmed start, normal ballast factor (PS-NBF): BF=0.88.



- c. Programmed start, high ballast factor (PS-HBF): BF = 1.04.
- 15. ANSI C82.2 Input Wattage for F25T8 Lamps:
  - a. As indicated on Table at Consortium for Energy Efficiency.
- E. Compact Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V), electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated; including the following features:
  - 1. Lamp end-of-life detection and shutdown circuit.
  - 2. Automatic lamp starting after lamp replacement.
  - 3. Sound Rating: Class A.
  - 4. Total Harmonic Distortion Rating: 10 percent or less.
  - 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  - 6. Operating Frequency: 20 kHz or higher.
  - 7. Lamp Current Crest Factor: 1.7 or less.
  - 8. Ballast Factor: 0.95 or higher unless otherwise indicated.
  - 9. Power Factor: 0.98 or higher.
  - 10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
  - 11. Dimming ballasts shall be as per above, except dimming range 5-100% of rated lamp lumens.

## 2.3 LAMPS

- A. Linear T8 Fluorescent Lamps:
  - 1. Rapid start fluorescent lamps shall comply with ANSI C78.1; and instant-start lamps shall comply with ANSI C78.3.
  - 2. Chromacity of fluorescent lamps shall comply with ANSI C78.376.
  - 3. Lamps shall be low-mercury energy saving type, otherwise indicated. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.
- a. T8 type:
  - 1) All 48 inch linear T8 lamps shall be qualifying products for High Performance T8 Systems, manufacturer and model number on the approved list at Consortium for Energy Efficiency:  
[www.ceel.org](http://www.ceel.org)

- 2) Lamp temperature: 3500 degree Kelvin, unless noted otherwise.
  - 3) Color rendering index: Not less than 82.
  - 4) Average rated life: 48 inch linear: 30,000 hours at 3 hours per start, programmed start. 24 inch linear: 30,000 hours at 3 hours per start, programmed start.
  - 5) Nominal wattage: 48 inch linear: 25 watts. 24 inch linear: 17 watts.
  - 6) Luminous intensity - Initial lumens: 48 inch linear: 2,500 lumens. 24 inch linear: 1450 lumens.
  - 7) Products: 48 inch linear: Philips 25W T8. 24 inch linear: Philips F17T8ADV835ALTO.
- b. Compact Fluorescent Lamps: 1. T4, CRI 80 (minimum), color temperature 3500 K, and suitable for use with dimming ballasts, unless otherwise indicated.
- c. Long Twin-Tube Fluorescent Lamps: T5, CRI 80 (minimum), color temperature between 3500° and 4100°K, 20,000 hours average rated life.

#### **2.4 EXIT LIGHT FIXTURES**

- A. Exit light fixtures shall meet applicable requirements of NFPA 101 and UL 924.
- B. Housing and Canopy:
1. Shall be made of die-cast aluminum.
  2. Steel housing shall have baked enamel over corrosion resistant, white.
- C. Door frame shall be cast or extruded aluminum, and hinged with latch.
- D. Finish shall be white.
- E. There shall be no radioactive material used in the fixtures.
- F. Fixtures:
1. Maximum fixture wattage shall be 5 watts or less.
  2. Inscription panels shall be cast or stamped aluminum a minimum of 0.090 inch [2.25mm] thick, stenciled with 6 inch [150mm] high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass. The LED shall be rated minimum 25 years life.
  3. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.

4. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings.  
Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltages: 120-277 volts, unless noted otherwise on Lighting Fixture Schedule on Drawings.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
- B. Individual light fixtures are to be connected by a whip no longer than 6' originating in an electrical junction box. Boxes can be shared among fixtures as long as they are strategically placed allowing for the 6' whip. The whip can be either FMC or HCF MC. No 'daisy chaining' light fixtures.
- C. Align, mount and level the lighting fixtures uniformly.
- D. Lighting Fixture Supports:
1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
  2. Shall maintain the fixture positions after cleaning and relamping.
  3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
  4. Hardware for recessed fluorescent fixtures:
    - a. Where the suspended ceiling system is supported at the four corners of the fixture opening, hardware devices shall clamp the fixture to the ceiling system structural members, or plaster frame at not less than four points in such a manner as to resist spreading of the support members and safely lock the fixture into the ceiling system.
    - b. Where the suspended ceiling system is not supported at the four corners of the fixture opening, hardware devices shall independently support the fixture from the building structure at four points.

- c. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
- 5. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.
- E. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.
- F. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.
- G. Bond lighting fixtures and metal accessories to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

### **3.2 FIELD QUALITY CONTROL**

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- C. Exercise electronic dimming ballasts over full range of dimming capability by operating the control devices(s) in the presence of the COR. Observe for visually detectable flicker over full dimming range.
- D. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless a lesser period is specifically recommended by lamp manufacturer. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage. Replace any lamps and ballasts which fail during burn-in.
- E. At completion of project, relamp/reballast fixtures which have failed lamps/ballasts. Clean fixtures, lenses, diffusers and louvers that

have accumulated dust/dirt/fingerprints during construction. Replace damaged lenses, diffusers and louvers with new.

F. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

G. Emergency Lighting Tests: Simulate power outage by turning power off to the circuit providing normal power to the light fixture.

1. Provide a report for each room or space that has emergency lighting installed. Indicate the following for each space:
  - a. Date of test.
  - b. List each type of emergency power transfer device/unit(s) and quantity of each installed.
  - c. Verification that each unit is in working order.
  - d. Verification that lamps have been aimed properly, for units that require aiming.
  - e. Duration of supply.
2. Repeat tests for deficient items. Simulate power outage by turning power off to the circuit providing normal power to the light fixture. Provide a cover sheet listing all deficient items. Provide new test report for each deficient item. Indicate the following:
  - a. Date of test.
  - b. Deficiency and corrective action taken.
  - c. Repeat tests/verifications in the original test report.

### 3.3 ADJUSTING

- A. Aim and adjust directional luminaires as directed, in the field, by the Engineer.
- B. Position exit sign directional arrows as indicated.

### 3.4 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures.
- C. Clean finishes and touch up damage.

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**SECTION 27 05 11**  
**REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section, Requirements for Communications Installations, applies to all sections of Division 27.
- B. Furnish and install communications cabling, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable, and other items and arrangements for the specified items are shown on drawings.

**1.2 MINIMUM REQUIREMENTS**

- A. References to industry and trade association standards and codes are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

**1.3 QUALIFICATIONS (PRODUCTS AND SERVICES)**

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
  - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
  - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

**1.4 MANUFACTURED PRODUCTS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
  - 2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
  - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

#### **1.5 EQUIPMENT REQUIREMENTS**

Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to conduits, wire, cabling, controls, panels and installation methods.

#### **1.6 EQUIPMENT PROTECTION**

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
  - 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
  - 2. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.

3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

#### **1.7 WORK PERFORMANCE**

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure communications service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and pathways with other trades to minimize interferences. See the GENERAL CONDITIONS.

#### **1.8 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Inaccessible Equipment:
  1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
  2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

#### **1.9 EQUIPMENT IDENTIFICATION**

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.



#### 1.10 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
  - 1. Mark the submittals, "SUBMITTED UNDER SECTION\_\_\_\_\_".
  - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  - 3. Submit each section separately.
- E. The submittals shall include the following:
  - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
  - 3. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
  - 4. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  - 1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.

2. Inscribe the following identification on the cover: the words  
"MAINTENANCE AND OPERATION MANUAL," the name and location of the  
system, equipment, building, name of Contractor, and contract number.  
Include in the manual the names, addresses, and telephone numbers of  
each subcontractor installing the system or equipment and the local  
representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to  
the table of contents, with tab sheets placed before instructions  
covering the subject. The instructions shall be legible and easily  
read, with large sheets of drawings folded in.
4. The manuals shall include:
  - a. Internal and interconnecting wiring and control diagrams with data  
to explain detailed operation and control of the equipment.
  - b. A control sequence describing start-up, operation, and shutdown.
  - c. Description of the function of each principal item of equipment.
  - d. Installation and maintenance instructions.
  - e. Safety precautions.
  - f. Diagrams and illustrations.
  - g. Testing methods.
  - h. Performance data.
  - i. Pictorial "exploded" parts list with part numbers. Emphasis shall  
be placed on the use of special tools and instruments. The list  
shall indicate sources of supply, recommended spare parts, and  
name of servicing organization.
  - j. Appendix; list qualified permanent servicing organizations for  
support of the equipment, including addresses and certified  
qualifications.
- G. Approvals will be based on complete submission of manuals together with  
shop drawings.
- H. After approval and prior to installation, furnish the COR with one  
sample of each of the following:
  1. A 300 mm (12 inch) length of each type and size of wire and cable  
along with the tag from the coils of reels from which the samples  
were taken.
  2. Each type of conduit and pathway coupling, bushing and termination  
fitting.
  3. Raceway and pathway hangers, clamps and supports.
  4. Duct sealing compound.

**1.11 SINGULAR NUMBER**

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

**1.12 TRAINING**

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the COR at least 30 days prior to the planned training.

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**SECTION 27 05 26**  
**GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, telecommunications system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

**1.2 RELATED WORK**

- A. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS:  
General electrical requirements and items that are common to more than one section of Division 27.
- B. Section 27 10 00, STRUCTURED CABLING: Low Voltage power and lighting wiring.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:
  - 1. Certification that the materials and installation is in accordance with the drawings and specifications.
  - 2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

**1.4 APPLICABLE PUBLICATIONS**

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the

extent referenced. Publications are referenced in the text by the basic designation only.

- A. American Society for Testing and Materials (ASTM):
  - B1-2012.....Standard Specification for Hard-Drawn Copper Wire
  - B8-2011.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 81-2012.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- C. National Fire Protection Association (NFPA):
  - 70-2014.....National Electrical Code (NEC)
- D. Telecommunications Industry Association, (TIA)
  - J-STD-607-B-2011.....Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- E. Underwriters Laboratories, Inc. (UL):
  - 44-2010 .....Thermoset-Insulated Wires and Cables
  - 83-2008 .....Thermoplastic-Insulated Wires and Cables
  - 467-2007 .....Grounding and Bonding Equipment
  - 486A-486B-2013 .....Wire Connectors

## **PART 2 - PRODUCTS**

### **2.1 GROUNDING AND BONDING CONDUCTORS**

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm<sup>2</sup> (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- C. Telecom System Grounding Riser Conductor (Telecommunications Bonding Backbone [TBB]): Telecommunications Grounding Riser shall be in accordance with J-STD-607B. Use a minimum 50mm<sup>2</sup> (1/0 AWG) insulated stranded copper grounding conductor unless indicated otherwise.

**2.2 GROUND RODS (NOT USED)**

**2.3 SPLICES AND TERMINATION COMPONENTS**

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

**2.4 TELECOMMUNICATION SYSTEM GROUND BUSBARS**

- A. Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as follows:
1. Telecom Grounding Busbar (TGB): 508 mm x 50 mm (18 inches x 2 inch).
  2. Telecom Main Grounding Busbar (TMGB): 610 mm x 101 mm (24 inches x 4 inch).

**2.5 GROUND CONNECTIONS**

- A. Above Grade:
1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
  2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
  3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.
- B. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

**2.6 EQUIPMENT RACK AND CABINET GROUND BARS**

- A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x 3/4 inch).

**2.7 GROUND TERMINAL BLOCKS**

- A. At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

**2.8 SPLICE CASE GROUND ACCESSORIES**

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

### **3.3 SECONDARY EQUIPMENT AND CIRCUITS**

- A. Conduit Systems:
  - 1. Ground all metallic conduit systems and wireways. All metallic conduit systems shall contain an equipment grounding conductor.
  - 2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
  - 3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- B. Boxes, Cabinets, Enclosures, and Panels:
  - 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
  - 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

### **3.4 CORROSION INHIBITORS**

- A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

### 3.5 TELECOMMUNICATIONS SYSTEM

- A. Bond telecommunications system grounding equipment to the electrical grounding electrode system directly from the TMGB.
- B. Furnish and install all wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
- C. Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.
- D. Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milli ohms or less.
- E. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.
- F. Bonding Jumpers:
  - 1. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 16 mm<sup>2</sup> (6 AWG) insulated copper wire.
  - 2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
  - 3. Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.
- G. Bonding Jumper Fasteners:
  - 1. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.
  - 2. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.



3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
4. Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

### **3.6 COMMUNICATION ROOM GROUNDING**

#### **A. Telecommunications Ground Busbars:**

1. Provide communications room telecommunications ground busbar hardware at 950 mm (18 inches) at locations indicated on the Drawings.
2. Connect the telecommunications room ground busbars to other room grounding busbars as indicated on the Grounding Riser diagram.

#### **B. Telephone-Type Cable Rack Systems: aluminum pan installed on telephone-type cable rack serves as the primary ground conductor within the communications room. Make ground connections by installing the following bonding jumpers:**

1. Install a 16 mm<sup>2</sup> (6 AWG) bonding between the telecommunications ground busbar and the nearest access to the aluminum pan installed on the cable rack.
2. Use 16 mm<sup>2</sup> (6 AWG) bonding jumpers across aluminum pan junctions.

#### **C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:**

1. When ground bars are provided at the rear of lineup of bolted together equipment racks, bond the copper ground bars together using solid copper splice plates supplied by the ground bar manufacturer.
2. Bond together nonadjacent ground bars on equipment racks and cabinets with 16 mm<sup>2</sup> (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
3. Provide a 16 mm<sup>2</sup> (6 AWG) bonding jumper between the rack and/or cabinet ground busbar and the aluminum pan of an overhead cable tray or the raised floor stringer as appropriate.

#### **D. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to the aluminum pan in the telephone-type cable tray using an insulated 16 mm<sup>2</sup> (16 AWG) bonding jumper.**

E. Other Communication Room Ground Systems: Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable tray pan or the telecommunications ground busbar, whichever is closer, using insulated 16 mm<sup>2</sup> (6 AWG) ground wire bonding jumpers.

### **3.7 COMMUNICATIONS CABLE GROUNDING**

A. Bond all metallic cable sheaths in multipair communications cables together at each splicing and/or terminating location to provide 100 percent metallic sheath continuity throughout the communications distribution system.

1. At terminal points, install a cable shield bonding connector provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector to an appropriate ground source like the rack or cabinet ground bar.
2. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or the splice case grounding and bonding accessories provided by the splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to an approved ground source and all other metallic components and equipment at that location.

### **3.8 COMMUNICATIONS CABLE TRAY SYSTEMS:**

- A. Bond the metallic structures of one cable tray in each tray run following the same path to provide 100 percent electrical continuity throughout this cable tray systems as follows:
1. Splice plates provided by the cable tray manufacturer can be used for providing a ground bonding connection between cable tray sections when the resistance across a bolted connection is 10 milliohms or less. The Subcontractor shall verify this loss by testing across one splice plate connection in the presence of the Contractor.
  2. Install a 16 mm<sup>2</sup> (6 AWG) bonding jumper across each cable tray splice or junction where splice plates cannot be used.
  3. When cable tray terminations to cable rack, install 16 mm<sup>2</sup> (6 AWG) bonding jumper between cable tray and cable rack pan.

### **3.9 COMMUNICATIONS RACEWAY GROUNDING**

- A. Conduit: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.
- B. Wireway: use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.
- C. Cable Tray Systems: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 16 meters (50 feet).

### **3.10 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Government. Final tests shall assure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

### **3.11 GROUND ROD INSTALLATION (NOT USED).**

- - - E N D - - -

**SECTION 27 05 33**  
**RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for all communications cabling unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

**1.2 RELATED WORK**

- A. Mounting board for communication closets: Section 06 10 00, ROUGH CARPENTRY.
- B. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- D. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- E. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- F. General electrical requirements and items that is common to more than one section of Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- G. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

**1.3 SUBMITTALS**

In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

- A. Shop Drawings:
  - 1. Size and location of panels and pull boxes
  - 2. Layout of required conduit penetrations through structural elements.
  - 3. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the COR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

#### 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):  
70-2014.....National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL):  
1-2005.....Flexible Metal Conduit  
5-2011.....Surface Metal Raceway and Fittings  
6-2007.....Rigid Metal Conduit  
50-2010.....Enclosures for Electrical Equipment  
360-2013.....Liquid-Tight Flexible Steel Conduit  
467-2007.....Grounding and Bonding Equipment  
514A-2013.....Metallic Outlet Boxes  
514B-2012.....Fittings for Cable and Conduit  
514C-2007.....Nonmetallic Outlet Boxes, Flush-Device Boxes and  
Covers  
651-2011.....Schedule 40 and 80 Rigid PVC Conduit  
651A-2011.....Type EB and A Rigid PVC Conduit and HDPE Conduit  
797-2007.....Electrical Metallic Tubing  
1242-2006.....Intermediate Metal Conduit
- D. National Electrical Manufacturers Association (NEMA):  
TC-3-2004.....PVC Fittings for Use with Rigid PVC Conduit and  
Tubing  
FB1-2012.....Fittings, Cast Metal Boxes and Conduit Bodies  
for Conduit, Electrical Metallic Tubing and  
Cable

#### PART 2 - PRODUCTS

##### 2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 1 inch unless otherwise shown.
- B. Conduit:
1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
  2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
  3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.

4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 103 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
5. Flexible galvanized steel conduit: Shall Conform to UL 1.
6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
7. Surface metal raceway: Shall Conform to UL 5.

C. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  - d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
  - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of setscrews with pliers is prohibited.
  - f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Rigid aluminum conduit fittings:
  - a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
  - b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
  - c. Set screw fittings: Not permitted for use with aluminum conduit.
3. Electrical metallic tubing fittings:

- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 53 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use setscrews of casehardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
  - d. Indent type connectors or couplings are prohibited.
  - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible steel conduit fittings:
- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp type, with insulated throat.
5. Liquid-tight flexible metal conduit fittings:
- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
6. Surface metal raceway fittings: As recommended by the raceway manufacturer.
7. Expansion and deflection couplings:
- a. Conform to UL 467 and UL 514B.
  - b. Accommodate, 21 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
  - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
- 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.

2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  3. Multiple conduit (trapeze) hangers: Not less than 41 mm by 41 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
  4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
  2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
  3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
  4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Pull Wire: Provide with 200 lbs. minimum tensile strength.

### **PART 3 - EXECUTION**

#### **3.1 PENETRATIONS**

- A. Cutting or Holes:
1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COR prior to drilling through structural sections.
  2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Resident Engineer as required by limited working space.
- B. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Utilize a national recognized testing laboratory (NRTL) listed firestopping assembly. Completely fill and seal clearances between raceways and openings with the fire stop material. Provide re-enterable mechanical smoke-tight fire-stop where quantity of cables is



greater than 50 or where cabling is penetrating the telecom room walls or floors.

- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

### **3.2 INSTALLATION, GENERAL**

A. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height headroom, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 8'0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

C. Layout:

1. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COR.

### **3.3 CONCEALED WORK INSTALLATION**

- A. Furred or Suspended Ceilings and in Walls:
  1. Conduit for conductors 600 volts and below:
    - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
  2. Align and run conduit parallel or perpendicular to the building lines.
  3. Tightening setscrews with pliers is prohibited.

### **3.4 EXPOSED WORK INSTALLATION**

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 volts and below:
  1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight-foot) intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
  1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
  2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 53 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

### **3.5 EXPANSION JOINTS**

- A. Conduits 78 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 78 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch)

vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

- C. Install expansion and deflection couplings where crossing an expansion joint.

### **3.6 CONDUIT SUPPORTS, INSTALLATION**

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
    - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 78 mm (3 inches).
    - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, Rawl Plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for

cable and wire with fittings that include internal wedges and retaining collars.

### **3.7 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush mounted.
  - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

### **3.11 COMMUNICATION SYSTEM CONDUIT**

- A. Install the communication raceway system as shown on drawings.
- B. Minimum conduit size of 21 mm (1 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 103 mm (4 inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors shall terminate not less than 78 mm (3 inches) below the floor and not less than 78 mm (3 inches) below the ceiling of the floor below.
- F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.
- G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams. X-ray the floor as required and consult with general contractor prior to core drilling.
- H. All empty conduits located in communication closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- I. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size inches	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

J. Furnish and install 21 mm (3/4 inch) thick fire retardant plywood specified in Section 06 10 00, ROUGH CARPENTRY on the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.

K. Furnish a pull wire in all empty conduits. (Sleeves through floor are exceptions).

### 3.12 MODULAR FURNITURE FEED (NOT USED)

- - - E N D - - -

**SECTION 27 05 36**

**CABLE TRAYS FOR TELECOMMUNICATION SYSTEMS**

**Part 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing of all necessary labor, supervision, materials, equipment, installation, tests, and services to completely execute a complete wire basket cable tray system as described in this specification and as shown on the drawings.
- B. Wire basket cable tray systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, dropouts, supports and accessories.
- C. This section includes steel, cable trays and accessories.

**1.2 RELATED WORK**

- A. Section 27 05 11, Requirements for Communications Installations.
- B. Section 27 05 26, Grounding and Bonding for Communications Systems.
- C. Section 27 05 33, Raceways and Boxes for Communications Systems.

**1.3 DRAWINGS**

- A. The drawings, which constitute a part of these specifications, indicate the general route of the wire basket cable tray systems. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.
- B. Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include the location of system equipment grounding connections.

3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.
- C. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:
  1. Certification that the materials and installation is in accordance with the drawings and specifications.
  2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

#### 1.5 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) for a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

- A. American Society for Testing and Materials (ASTM) International:
  - ASTM A1011 / A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
  - ASTM A123 / A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - ASTM A510 - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
  - ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
  - ASTM A580 - Standard Specification for Stainless Steel Wire.
  - ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
  - ASTM A641 / A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - ASTM A653 / A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 81-2012.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- C. National Fire Protection Association (NFPA):

70-2014.....National Electrical Code (NEC)

D. National Electrical Manufacturers Association:

NEMA VE 1 - Metal Cable Tray Systems.

NEMA VE 2 - Cable Tray Installation Guidelines.

E. Telecommunications Industry Association, (TIA)

J-STD-607-B-2011.....Generic Telecommunications Bonding and  
Grounding (Earthing) for Customer Premises

F. Underwriters Laboratories, Inc. (UL):

44-2010 .....Thermoset-Insulated Wires and Cables

83-2008 .....Thermoplastic-Insulated Wires and Cables

467-2007 .....Grounding and Bonding Equipment

486A-486B-2013 .....Wire Connectors

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

A. Delegated Design: Engage a qualified professional engineer to  
design cable tray supports and bracing.

**2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS**

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and  
marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from  
single manufacturer.

B. Sizes and Configurations: As indicated on the Drawings.

C. Structural Performance: See article on individual cable tray  
types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly  
distributed load on the indicated support span when supported as  
a simple span and tested according to NEMA VE1.

2. Concentrated Load: A load applied at midpoint of span and  
centerline of tray.

3. Load and Safety Factors: Applicable to both side rails and rung  
capacities.

**2.3 WIRE BASKET CABLE TRAY SECTIONS AND COMPONENTS**

A. Provide wire basket cable tray of types and sizes indicated with  
connector assemblies, clamp assemblies, connector plates, splice  
plates and splice bars. Construct units with rounded edges and  
smooth surfaces; in compliance with applicable standards; and with  
the additional construction highlighted in this section.



- B. All straight section longitudinal wires shall be constructed with a continuous top wire safety edge. Safety edge must be kinked and T-welded on all tray sizes.
- C. Wire basket cable tray shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.
- D. Wire basket cable tray sizes shall conform to the following nominal criteria:
  - 1. Straight sections shall be furnished in standard 118.3 inch lengths.
  - 2. Wire diameter shall be 0.196" (5mm) minimum on all mesh sections.
  - 3. Wire basket cable tray shall have a minimum 4 inch usable loading depth by [4] [6] [8] [12] [16] [18] [20] [24] [30] inches wide.
- E. The system is required to abide by the grounding and bonding requirements in specification 27 05 26 Grounding and Bonding for Communications Systems.
- F. Material and Finishes: Material and finish specifications for Pre-Galvanize Steel Wire are as follows.
  - 1. Electro-Plated Zinc Galvanizing: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510, Grade 1008 and shall be electro-plated zinc in accordance with ASTM B633, Type III, SC-1.
  - 2. Pre-Galvanized Zinc: Straight sections shall be made from pre-galvanized steel meeting the minimum mechanical properties of ASTM A641.
  - 3. Hot Dipped Galvanizing: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510, Grade 1008 and shall be hot dipped galvanized after fabrication in accordance with ASTM A123.
- G. All fittings shall be field formed from straight sections in accordance with manufacturer's instructions.
- H. Wire basket cable tray supports shall be center support hangers, trapeze hangers or wall brackets as approved by COR.
- I. Trapeze hangers or center support hangers shall be supported by 3/8" inch diameter rods.

J. Special accessories shall be furnished as required to protect, support and install a wire basket cable tray system.

#### **2.4 QUALITY ASSURANCE**

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the COR.
- B. Supply all equipment and accessories new and free from defects.
- C. Supply all equipment and accessories in compliance with the applicable standards listed in Part 1.5 of this section and with all applicable national, state and local codes.
- D. All items of a given type shall be the products of the same manufacturer.
- E. Zinc plated wire basket cable tray shall be classified by Underwriters Laboratories (UL).
- F. Wire basket cable tray shall be of uniform quality and appearance.
- G. Comply with the National Electrical Code (NEC), as applicable, relating to construction and installation of cable tray and cable channel systems (Article 392, NEC).
- H. Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

### **PART 3 - EXECUTION**

#### **3.1 EXISTING WORK**

- A. Extend existing wire basket cable tray installations using materials and methods [compatible with existing installation(s), or] as specified.
- B. Clean and repair existing wire basket cable tray to remain or to be reinstalled.

#### **3.2 CABLE TRAY INSTALLATION**

- A. Install cable trays according to NEMA VE 2.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

- D. Remove burrs and sharp edges from cable trays.
- E. Where supported by All Threaded Rod (ATR), use a minimum of 3/8" rod.
- F. Fasten cable tray supports to building structure.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb.
- H. Place supports so that spans do not exceed maximum support spans/loading capacity on load & fill chart schedules as provided by the product manufacturer. Provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Supports shall be installed providing the maximum load rating of the specific size of tray installed.
- J. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- K. Support bus assembly to prevent twisting from eccentric loading.
- L. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- M. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
- N. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.
- O. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- P. Make changes in direction and elevation using standard fittings.
- Q. Make cable tray connections using manufacturer's recommended fittings.
- R. Seal penetrations through fire and smoke barriers. Comply with requirements for "Penetration Firestopping" in Section 07 84 00 "Firestopping". Use firestop pillows where tray penetrates walls or floors.
- S. Install capped metal sleeves for future cables through firestop-

sealed cable tray penetrations of fire and smoke barriers.

- T. Install cable trays with enough workspace to permit access for installing cables.
- U. Coordinate wire basket cable tray with other work as necessary to properly interface installation of wire basket cable tray with the other work.
- V. Install barriers to separate cables of different systems, such as communications, patient monitoring, and data processing as directed by drawings.

### **3.3 CABLE TRAY BONDING**

- A. Bond cable trays according to NFPA 70 unless additional grounding or bonding is specified. Comply with requirements in Section 270526 "Grounding and Bonding for Communication Systems."

### **3.4 CABLE INSTALLATION**

- A. Install cables only when cable tray installation has been completed and inspected.
- B. Fasten cables on vertical runs to cable trays every 18 inches using Velcro straps.
- C. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.
- D. In existing construction, remove inactive or dead cables from cable tray.

### **3.5 CONNECTIONS**

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

### **3.6 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. After installing cable trays and after cabling is 'on-line', survey for compliance with requirements.
  - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibrations, and thermal expansion and contraction conditions, which may cause or have

caused damage.

3. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
4. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and re-torque in suspect areas.
6. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

### **3.7 PROTECTION**

A. Protect installed cable trays.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
2. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 26 05 36

**SECTION 27 08 00**  
**COMMISSIONING OF COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 27.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.

**1.2 RELATED WORK**

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

**1.3 SUMMARY**

- A. This Section includes requirements for commissioning the communications systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.
- C. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED™ rating program and to support delivery of project performance in accordance with the Contract Documents developed with the approval of the VA.
  - 1. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" prerequisite of "Fundamental Building Systems Commissioning".
  - 2. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.
  - 3. Activities and documentation for the LEED™ section on "Measurement and Verification" requirements for the Measurement and Verification credit.

- D. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

#### **1.4 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

#### **1.5 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.
- B. The following Communications systems will be commissioned:
  - 1. Facility Telecommunications and Data Distribution Systems.

#### **1.6 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the COR prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent

determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### **3.2 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 27 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### **3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### **3.4 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction



to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 27 Sections for additional Contractor training requirements.

----- END -----

**SECTION 27 10 00  
STRUCTURED CABLING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of the structured cabling system to provide a comprehensive telecommunications infrastructure.

**1.2 RELATED WORK**

- A. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

**1.3 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Manufacturer's Literature and Data: Showing each cable type and rating.
  2. Certificates: Two weeks prior to final inspection, deliver to the COR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

**1.4 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):  
D2301-2010.....Standard Specification for Vinyl Chloride  
Plastic Pressure Sensitive Electrical Insulating  
Tape
- C. Federal Specifications (Fed. Spec.):  
A-A-59544A-2008.....Cable and Wire, Electrical (Power, Fixed  
Installation)
- D. National Fire Protection Association (NFPA):

- 70-2014.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
- 44-2010.....Thermoset-Insulated Wires and Cables
- 83-2008.....Thermoplastic-Insulated Wires and Cables
- 467-2007.....Electrical Grounding and Bonding Equipment
- 486A-2013.....Wire Connectors and Soldering Lugs for Use with  
Copper Conductors
- 486C-2013.....Splicing Wire Connectors
- 486D-2005.....Insulated Wire Connector Systems for Underground  
Use or in Damp or Wet Locations
- 486E-2009.....Equipment Wiring Terminals for Use with Aluminum  
and/or Copper Conductors
- 493-2007.....Thermoplastic-Insulated Underground Feeder and  
Branch Circuit Cable
- 514B-2012.....Fittings for Cable and Conduit
- 1479-2003.....Fire Tests of Through-Penetration Fire Stops

## **PART 2 - PRODUCTS**

### **2.1 CONTROL WIRING**

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

### **2.2 COMMUNICATION AND SIGNAL WIRING**

- A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide larger wiring as required for the systems being furnished if required.
- C. Multi-conductor cables shall have the conductors color coded.

### **2.3 WIRE LUBRICATING COMPOUND**

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

### **2.4 FIREPROOFING TAPE**

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

**PART 3 - EXECUTION**

**3.1 INSTALLATION, GENERAL**

- A. Install all wiring in raceway systems.
- B. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- C. Wire Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
  - 2. Use ropes made of nonmetallic material for pulling feeders.
  - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer.
  - 4. Pull in multiple cables together in a single conduit.

**3.2 INSTALLATION IN MANHOLES (NOT USED)**

**3.3 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION**

- A. Unless otherwise specified in other specification sections; install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

**3.4 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION**

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.

**3.5 EXISTING WIRING**

- A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

- - - E N D - - -

**SECTION 271200**  
**TELECOMMUNICATIONS CABLING EXPANSION**

**GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections.

**1.2 SUMMARY**

- A. This section includes installation, testing, documentation and training for a fully functional local area network cabling infrastructure.
- B. Furnish and install Horizontal UTP Copper cabling, patch panels, patch cords, termination units, horizontal cross-connects, information outlets, respective cable termination connections, and other items necessary to "terminate" selected information outlets (IO) as shown on the Drawings.

**1.3 WORK PROVIDED UNDER OTHER SECTIONS**

- A. Data cabling pathways, power wiring devices, lighting, cooling and other work related to the Local Area Network infrastructure will be provided by the Electrical Contractor unless noted otherwise.

**1.4 WORK FURNISHED, INSTALLED, AND CONNECTED BY OTHER**

- A. Electronic data communication equipment is not specified under this contract.

**1.5 SUBMITTALS**

- A. Submit a complete list of all proposed equipment and materials, including manufacturer's specifications and product cut sheets prior to purchase.
- B. Submit schedule of inspections showing all milestones including initial inspection and site layout, rough-in inspection, terminations including cross-connects, testing, and final inspection.
- C. Submit a labeling scheme approved by the Owner and the Government.
- D. Telecommunications Maintenance Manual. Furnish one (1) complete Telecommunications Maintenance Manual containing the following:
  - 1. Descriptions of network cabling equipment and normal operating procedures.
  - 2. Riser Diagrams showing complete installed UTP and Fiber cabling.
  - 3. Proof of Performance Report outlining the operating parameters tested, complete test results, and a summary of industry standards used for each parameter.
  - 4. Warranty information.
- E. Submit a schedule of existing telecommunication demolition – Existing cables and jacks scheduled to be removed shall be documented with voice and data jack location (room, plate location number, jack) and identification of the termination location in the telecommunication closet.

**1.6 APPLICABLE PUBLICATIONS, STANDARDS, CODES, TESTING LABORATORIES, GUIDELINES**

- A. ANSI/EIA/TIA Standard 568B.1, 568B.2, AND 568B.3
- B. ANSI/EIA/TIA Standard 569
- C. ANSI/EIA/TIA Standard 606
- D. ANSI/EIA/TIA Standard 607
- E. Technical Service Bulletins TSB-36, TSB-40, TSB 67
- F. NFPA 70e National Electrical Code.

- G. Provide products specified in this section that are listed and labeled. The terms "listed" and "labeled": As defined in the "National Electrical Code," Article 10G0.

#### **1.7 QUALITY ASSURANCE**

- A. Contractor shall be currently licensed to install low-voltage cabling infrastructures in the state where the facility is located.
- B. Contractor shall meet manufacturer's requirements for the provision and installation of specified equipment.
- C. Contractor shall provide proof of certification as a structured cabling infrastructure installer for the system provided under this bid.
- D. Contractor shall utilize the following test equipment, or better, and shall have operators trained for use of such equipment:
  - 1. Copper Cable Test Equipment:
    - a. Fluke / MicroTest (level 3 tester)
    - b. Agilent WireScope 350 (level 3 tester).
    - c. Prior approved equal.
  - 2. Fiber Optic Cable Test Equipment: (if fiber is included in the installation)
    - a. Approved OTDR.
    - b. Approved OLS/OPM.

#### **1.8 PROJECT/SITE CONDITIONS**

- A. Examine areas and conditions under which the system is to be installed, and notify COR in writing of conditions detrimental to proper completion of the work. Do not proceed with that portion of the work affected until unsatisfactory conditions have been corrected in an acceptable manner.

#### **1.9 MANUFACTURER**

- A. Subject to compliance with specified requirements, provide specified materials, or similar to the referenced products included for the design of the Local Area Network Cabling infrastructure.

#### **1.10 UPGRADED PRODUCTS**

- A. Due to the fast-changing technology, products shall be the most current and up-to-date quality and labor-saving versions available for the application, unless otherwise restricted.
- B. Prior to bidding, provide written notification of any discrepancies in model or part numbers specified. Corrections will be clarified by addendum.
- C. Prior to bidding, provide written notification to COTR of announced discontinuation or upgrade replacements of specified materials.
- D. Provide necessary supplies, mounting hardware and accessories required to install specified materials.

#### **1.11 PRODUCT SUBSTITUTION**

- A. Manufacturer substitutions will be allowed for the structured cabling infrastructure only if the contractor proves the specifications of the product match or exceed what is specified by the Government.

**Specified Material List**

Category	Item	Part #	Manufacturer	Estimated Quantity
Jack Locations	Indicated on plan			
Face Plates				
Stainless	4 Port	CFPL4SY	Panduit	
Stainless	6 Port	CFPL6SY	Panduit	
Stainless	8 Port	CFPL8S-2GY	Panduit	
Stainless	Wall phone	KWPY		
Jacks				
Data and voice	Cat 6A black	CJ6X88TGIWBL	Panduit	
U of MN	Cat 3 Orange	CJ6X88TGIWOR	Panduit	
Biomed	Cat 6A Red	CJ6X88TGIWRD	Panduit	
	Wall Phone Jack	CJ6X88TGIWBL	Panduit	
Patch Panels				
	24 Port angled	DPA246X88TGY	Panduit	
	48 Port angled	DPA486X88TGY	Panduit	
Cable supports				
	Cable trays	Flextray	B-line	
	Ladder Rack	Cable Runway	CPI	
	4" J-Hook	181120	Caddy	
	2" J-Hook	181100	Caddy	
Fasteners				
	Velcro 3/4"		Panduit	
Jack Supports				
	Single Gang	LV-1	Arlington	
	Double Gang	LV-2	Arlington	
Cable				
	Cat 6A black riser	See cable specs		
	25 pair copper			
Fire Stop				



<b>Category</b>	<b>Item</b>	<b>Part #</b>	<b>Manufacturer</b>	<b>Estimated Quantity</b>
Grounding				
	#6 CU 19-Strand Green	See Div 26 specs		
	Lug #6 long Barrel 2 Hole	YA6C-2TC14	Burndy	
	Tag	LTYK	Panduit	
	Bonding Washer	RGW-100-1	Panduit	
	Ground Bar 19"x3/4"x1/4"	DGTB420	Hoffman Electric	
	Main Ground Bar	GB2B0312TPI-1	Panduit	
Cross Connect				
	1 Pr Wh/Gn 24 ga		General	
Patch Cords Cat 6A	*Unbooted RJ45			
	Black - 3'	UTP6A3BL	Panduit	60
	Black - 5'	UTP6A5BL	Panduit	30
	Black - 7'	UTP6A7BL	Panduit	5
	Black - 14'	UTP6A14BL	Panduit	5
	White - 3'	UTP6A3	Panduit	10
	White - 5'	UTP6A5	Panduit	10
	Red- 3'	UTP6A3RD	Panduit	5
	Red- 5'	UTP6A5RD	Panduit	5
	Violet- 3'	UTP6A3VL	Panduit	10
	Violet - 5'	UTP6A5VL	Panduit	10
	Violet- 7'	UTP6A7VL	Panduit	10
Station Cords Cat 6A	*Unbooted RJ45			
	Black 5'	UTP6A5BL	Panduit	10
	Black 7'	UTP6A7BL	Panduit	10
	Black 14'	UTP6A14BL	Panduit	5
	Violet - 5'	UTP6A5BVL	Panduit	5
	Violet - 10'	UTP6A10BVL	Panduit	10
	White - 5'	UTP6A5	Panduit	10
	White - 7'	UTP6A7	Panduit	10

### **1.12 MANUFACTURER'S CERTIFICATION**

- A. Manufacturer of cabling products shall be ISO9001 Certified.

### **1.13 UTP COPPER CABLE LENGTHS, TERMINATIONS, MARKINGS**

- A. Copper Cable runs shall be compliant with EIA/TIA recommended lengths: Horizontal cables shall not exceed 295 feet. Cable runs shall be continuous with no allowance for splicing.
- B. For construction on Mpls VAMC Campus: Copper cable Eight-Position Jack Pin/Pair Assignments shall match the VA Hospital's existing facilities. Coordinate with the COTR prior to installation.

## **PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide a certified structured cabling infrastructure by: General Cable or similar.
- B. Data Cable: blue.
- C. Voice Cable: white.

### **2.2 EQUIPMENT RACK:**

- A. Rack: Universal Rack, Chatsworth Products, Inc, Model 48353-X15 or approved equal, that shall hold 1,500 lbs of equipment, has integrated grounding, and is available as UL and cUL listed communications circuit accessory component.
  - 1. 96 inches tall, 15 inches deep. Equipment space – width = 19 inches, depth = 20 inches.
  - 2. Equipment shall be able to attach to the front and/or rear of the 3 inch deep vertical mounting channel with screws. Equipment mounting positions shall be marked and numbered.
  - 3. Open floor-mount two-post rack. Supports 19 inch wide rack-mount equipment and shelves.
  - 4. C-shaped equipment mounting channels.
  - 5. EIA-310-D compliant, hole pattern.
  - 6. 5/8 inch – 5/8 inch – 1/2 inch vertical hole spacing.
  - 7. Threaded #12-24 equipment mounting holes.
  - 8. Fixed in place – at a minimum anchored to floor and affixed to wall with bracing wherever possible.
  - 9. Provide 2 side vertical cable management. Cables shall be organized by rack mount space.
  - 10. Ground and bond in accordance with NFPA.
  - 11. Provide (2) horizontal Power Distribution Units (PDUs) per rack.
  - 12. Rack position in room as shown on drawings or as agreed at pre-construction meeting

### **2.3 CABLE SUPPORT**

- A. Horizontal cable management in rack: Master Cabling Section, Part Number 30092-X15 or 30093-X15 for single-sided installations, Chatsworth Products, Inc, or approved equal. Master Cabling Section, Part Number 30095-X15 or 30096-X15 for double-sided installations, Chatsworth Products, Inc, or approved equal.
  - 1. Extra-wide, contoured cable guides for smooth movement. UL94V-0 Flame Resistant Standard compliant.
  - 2. Ability to switch cover from right to left opening or remove entirely for access.
  - 3. Edge-protected pass through ports and vertical slots for strapping.
- B. Supply velcro straps, length and strength as required to properly organize and bundle cables.

- C. Install cables in conduit and wireway systems provided by the Electrical Contractor. Coordinate with the Electrical Contractor for specific requirements. Conduit and wireway systems can only contain low voltage cable for VA connections.

## **2.4 CATEGORY 6A CHANNEL**

- A. The Category 6A - 4 pair UTP channel consists of all cable and components with up to four connections that comprise the full 100 meter circuit from the LAN Electronics to the work station device. The channel shall support applications such as 10Base-T, 100Base-T, 155 Mbs ATM, 77 channel broadband video, 1.0 Gbps Ethernet, 1.2 Gbps, and proposed 2.4 Gbps ATM technologies.
- B. The channel shall include the patch panels, horizontal cabling, and the station cord, and shall have a positive PSACR across the full frequency range of 1MHz - 250MHz.
- C. All components shall be backward compatible with existing Category 3, 4, 5 and 6 networks.
- D. The cabling channel with specified manufacturers above shall exceed Category 6A requirements.

## **2.5 INFORMATION OUTLETS**

- A. Activations: 4 outlets will be required at each location shown on the plans with tabs down, unless indicated otherwise. Number of jacks per location is indicated on plan.
- B. Modular Faceplates: Ivory, smooth nylon, UL rated 94V-O high impact, flame-retardant, thermoplastic, integral label card and cover, sized as follows:
  - 1. Data information outlets: Devices shown on plans as data information outlets shall be four position faceplates. Panduit 4 position face plate Part Number UICFPSE4EI.
  - 2. Telephone information outlets: same as data.
  - 3. In lieu of plastic provide stainless steel or brushed aluminum faceplates in the following areas:
    - a. Operating rooms
    - b. Wall phone plates
- B. Modular Information outlets: Modular single information outlet designed for high-performance networking applications. Panduit gigaspeed information outlet:
  - 1. Data outlet Cat 6A 568B: See table above
  - 2. Voice outlet Cat 6A 568B: See table above
- C. Minimum electrical requirements:
  - 1. Insulation resistance: 500 MΩ minimum
  - 2. Dielectric withstand voltage 1,000 VAC RMS, 60 Hz, minimum contact-to-contact and 1,500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface.
  - 3. Contact resistance: 20 MΩ maximum
  - 4. Current rating: 1.5A at 68 degrees F per IEC Publication 512-3, Test 5b
- D. Dust Cover/Blank: Contractor shall provide dust covers for each outlet as required to close all faceplate openings.
- E. Where data/voice jacks are fished into a hollow wall space without a raceway, Arlington LV-1 or approved equal shall be used. Metal types such as Caddy brand are not allowed.

## **2.6 MODULAR PATCH PANELS**

- A. Furnish and install Modular Patch Panels, as per table above. The panels shall be 19-in. wide for rack mounting. The panels shall accommodate data jacks as per table above. Provide labeling strip above each jack.

- B. Contractor shall be responsible for sizing the modular patch panels according to the following specifications:
  - 1. Number of Modular Patch Panel Ports shall be 125 percent of the total number of terminated information outlets required for the VRT project.
  - 2. Patch panels shall be 24 port or 48 port.

## **2.7 PATCH CORDS**

- A. Provide Patch Cords, Panduit Gigaspeed D8CM, 24 AWG, polyfin, twisted, jacketed, with 8-position Modular Plug at each end.
  - 1. Data Color: Black
  - 2. Voice Color: White
  - 3. Printer color: Red
  - 4. Biomedical color: Violet
  - 5. GE: Yellow
- B. Lengths of patch cords shall comply with EIA/TIA 568B recommended lengths: Patch cords shall not exceed 20 feet. Provide varying lengths to suit data closet installation. Coordinate final length selection with COTR prior to ordering. Data Lengths: As specified in parts list

## **2.8 STATION CORD**

- A. Provide UTP Station Cord interconnection between the work location equipment and the data outlet. Cord shall be 24 AWG tinned copper stranded conductors insulated with solid polyfin, tightly twisted into individual pairs and jacketed with flame retardant PVC. An 8-position modular plug will be terminated to each end of the cords. These cords will match the installed Patch Cords in order to maintain the integrity of the Cat 6A Local Area Network UTP cabling infrastructure.
  - 1. Data color: Black
  - 2. Voice color: White
  - 3. Biomedical color: Purple
- B. Provide UTP Station Cords of the lengths specified in the parts list. Coordinate final length selection with VA. Station cord lengths for wall mounted phones shall not meet this requirement. Provide minimum suitable length of phone cord for connection to phone.

## **2.9 HORIZONTAL UTP CABLE**

- E. Furnish and install copper Unshielded Twisted-Pair (UTP) horizontal cable as follows:
  - 1. Cat 6A, riser rated, 24 AWG bare solid copper conductor. The cable shall conform to UL Type CMP listing for plenum and riser applications.
  - 2. Each cable sheath shall contain 4 pairs of unshielded copper twisted-pairs with each pair having a different twist ratio of 12 to 24 twists per foot. Each pair shall be separated by a pair isolator.
  - 3. The cables shall exceed the requirements of:
    - a. EIA/TIA 568B Commercial Building Wiring Standard Horizontal Cable Section for category 6A.
    - b. Riser - UL 910, CMP.
    - c. Cabling shall have a maximum nominal outside diameter of 0.275" or smaller
    - d. Cabling shall be U/UTP, or shall have a non-continuous shield that does not require bonding at the connectors/terminations
  - 4. The cables shall meet the following representative electrical and transmission characteristics:

- a. Mutual Capacitance - nom. = 14 nF/1000 ft.
- b. DC Resistance - max. = 29 ohms/1000 ft. (9.4 ohms/100m).
- c. Gbps 4 Pair Cable Performance Characteristics as follows:

Frequency MHz	Attenuation DB/100m	Power Sum NEXT dB
1	2.3	62.0
4	4.2	60.5
8	5.8	55.6
10	6.5	54.0
16	8.2	50.6
20	9.2	49.0
25	10.2	47.3
31.25	11.5	45.7
62.5	16.4	40.6
100	20.9	37.1
200	30.1	31.9
250	33.9	30.2
300	37.4	28.8
400	43.7	25.8
500	49.3	23.2

5. Worst case channel performance requirements at 500 MHz and 100m (and shall Outperform at lower frequencies as well) shall be

Factor:	EIA/TIA Compliant Values:	Required Values:
1) Attenuation (insertion loss):	45.3dB max	43.7dB max
2) NEXT:	33.8dB min	40.6dB min
3) PSNEXT:	31.8dB min	40.4dB min
4) ACR:	-11.4dB min	-2.0dB min
5) PSACR:	-13.4dB min	-2.7dB min
6) ELFEXT:	13.8dB min	21.8dB min
7) PSELFEXT:	10.8dB min	21.1dB min
8) Return loss:	15.2dB max	25.4dB min
9) Propagation Delay:	536ns min	546ns min
10) Delay Skew:	45ns max	40ns max

5. Provide color for all defined systems as follows: Black

**2.10 FIBER OPTIC CABLE: N/A.**

**2.10 FIBER TERMINATION UNITS: N/A.**

**2.11 FIBER TERMINATION CONNECTORS: N/A**

**2.12 FIBER PATCH AND WORKSTATION CORDS: N/A**

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Install equipment and components in accordance with manufacturer's written instructions, in compliance with NEC, and with recognized industry practices. Ensure that all work complies with specifications and serves the intent of the construction documents. Cabling and equipment shall be installed in accordance with good engineering practices as established by the EIA/TIA and the NEC.

**3.2 INSTALLATION**

A Cabling - General:

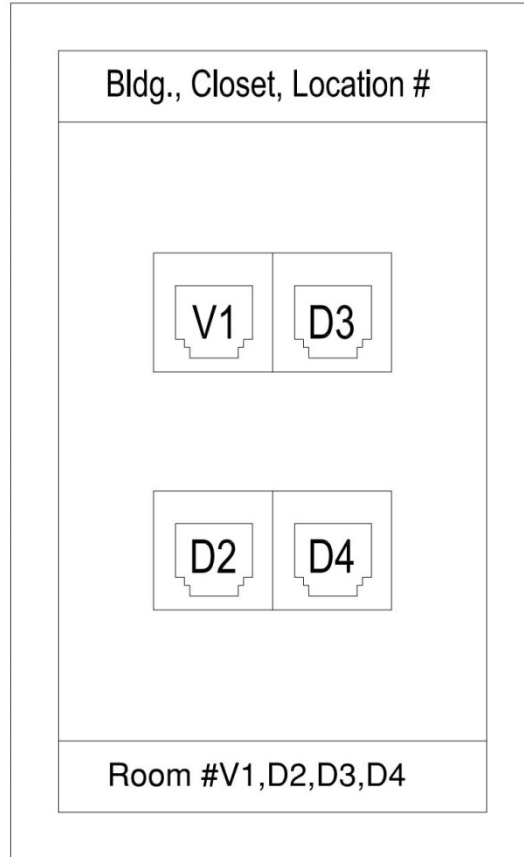
1. Provide dedicated horizontal cable runs from data closets to all "terminated" information outlets as described above and indicated on the Drawings. Cat 6A cables should be isolated from Cat 5e and Cat 6 cables.
2. Provide faceplates for all data and voice information outlets.
3. Where data or voice outlets are shown on plans, this Contractor shall provide jack termination, faceplate, and cabling.
4. Provide Modular Information Outlets in outlet boxes for all "terminated" data information outlets.
5. Excess cable behind faceplate connections shall be pulled back into ceiling spaces and secured in such a manner as to prevent damage to cabling or connections.
6. A minimum 10 foot loop of extra horizontal cable shall be secured in the accessible ceiling space.
7. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.
8. Avoid excessive and sharp bends that may damage cabling. Do not exceed manufacturer's recommended pulling tensions for backbone and horizontal cables.
9. Allow sufficient slack (10 feet) in cable to prevent premature deterioration of cable system components and to assist in the maintenance and servicing of cable and/or other building systems and components.
10. Provide cable trays and ladders as necessary to route and support cables from hallways to just above the rack in the I.T. closet. All cables shall be properly supported.
11. Provide Velcro straps to bundle and organize cabling for a quality and professional installation. Vinyl/plastic tie wraps are prohibited except where allowed in section 2.6.
12. Fittings or connections are allowed only at the input and output of devices. Splicing shall not be accepted in cable runs. Spliced cable runs shall be rejected and replaced with continuous cables, prior to acceptance.
13. Separation of Wires: Comply with EIA/TIA-568 rules for separation of UTP cables from potential EMI sources.

B. Telecom terminations and cross connects

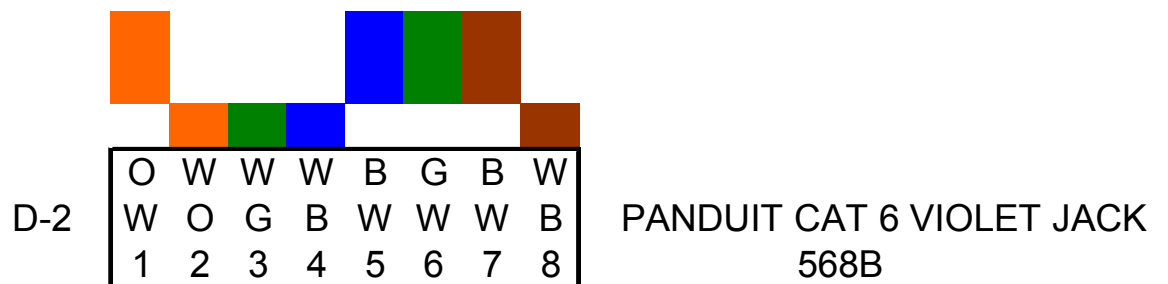
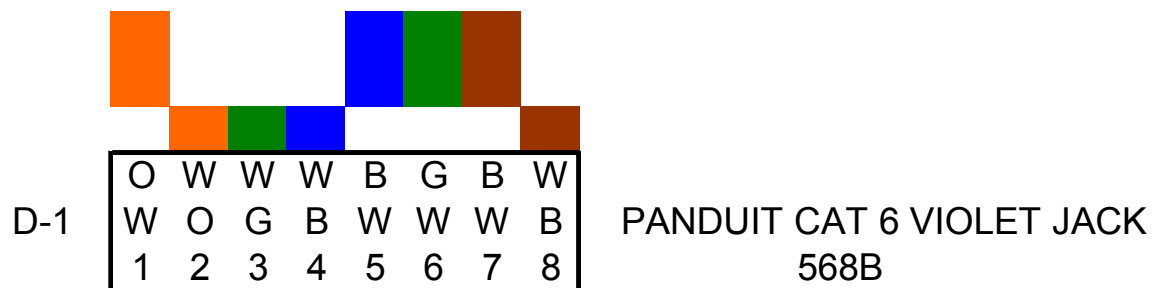
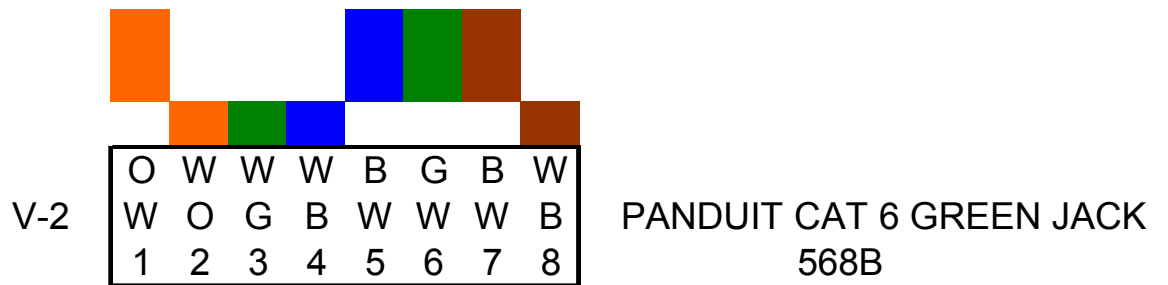
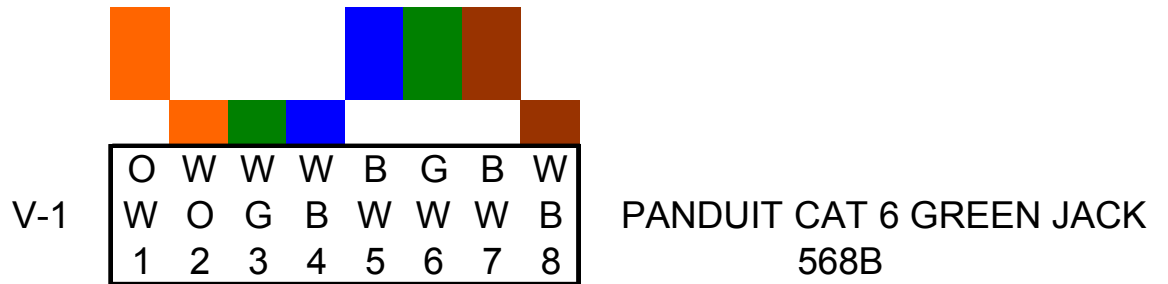
1. Riser pairs from the medical center switchroom (BH-111) terminate on 66 blocks in the IT closets distributed throughout the medical center and terminations from the voice outlets in the offices terminate on 66 or 110 blocks next to the riser blocks.
  2. The new voice cables from this project should terminate on patch panels on the rack in the IT closet similar to the data cables.
  3. To connect to the riser pairs, 66 blocks will be installed on the wall next to the riser blocks and be connected to a patch panel in the rack. The number of jacks will be equal to the number of available voice pairs.
  4. Cross connects- the contractor will be responsible for cross connecting the riser pairs to the new 66 block that is connected to the patch panel in the rack. Available riser pairs will be determined by the Government.
  5. Rack/cabinet elevations- elevations showing all rack mounted components will be provided by the VA in consultation with the contractor.
- C. Installation of rack in IT closet
1. Contractor will be responsible for installation of rack in low voltage closet to replace wall mounted racks. This will include
    - a. Consultation with COR regarding placement and cable management to include ladder rack if needed above rack
    - b. Audit of existing connections (VA will provide rack elevations)
    - c. After-hours cutover working with VA staff
    - d. Cable management
    - e. Clean up and labeling
- D. All cabling outside the data closet shall be routed in conduit or raceway as far as practically possible. The raceway shall be installed by the electrical contractor. Cables shall be run in the interstitial wireway as far as possible before penetrating the interstitial floor. The cabling may be run above the ceiling by an approved cabling system in a clean and workman like manner horizontally no longer than 20' unless approved by the COTR. For open wall construction cabling shall be installed in a minimum ¾" EMT conduit from the data box to a bushed stub out above the ceiling. For closed wall construction cabling may be fished through the wall without the use of a raceway system.
- E. Conduit, wireway, raceway, and/or sleeve fill shall not exceed 40%. Each conduit end not terminated in a box shall be equipped with a protective insulator or sleeve to cover the conduit end to protect the wire or cable during installation and remaining in the conduit.
- F. Sleeving: All cabling penetrating a wall or floor and not in a raceway shall be sleeved. A penetrator sleeve system and method for using same provides an encasement for wires and cables passing through a wall or floor. The system should include appropriate securing devices for tightly retaining the penetrant in place. This will also create a space between the penetrant and surrounding structure, which must be fire stopped in order to restore the fire-resistance rating of the parent assembly. The penetrant shall be one of the following;
1. EMT conduit with bushed ends.
  2. Prefabricated fire-rated pathway.
  3. Recommend the following or similar. Follow manufacturer's conduit fill recommendations.
    - a. EZ-PATH Fire Rated Pathway
    - b. Spec Seal Ready Sleeve

- G. Firestopping: Provide fire stopping after cabling installation at all fire wall/floor penetrations.
- H. Grounding: The general contractor shall be responsible for installing a ground bus adjacent to the cabinets. Ground all cabinets and cable runway to this ground bus. The contractor shall provide a #6 copper conductor from each rack/runway to the ground bus. Ground equipment per manufacturers' instructions and NEC requirements.
- I. Labeling, in accordance with VA Standards:
  - 1. Use Owner's room numbers for labeling. Confirm room numbers with Owner's Representative prior to labeling. See attached graphical information for labeling of face plates.
  - 2. Utilize manufacturer designed labeling method at Outlet and Patch Panels. Labeling method shall be permanent and minimally susceptible to vandalism. Labels shall be permanent, and contractor shall replace fallen labels as part of the warranty.
  - 3. Utilize the following labeling scheme:





4. Jack and Block Terminations as follows:



5. Label Faceplates for outlet locations. Jack numbering will begin at the first jack on the left hand wall as you enter the room and be labeled clockwise around the room. Continue the numbering sequence throughout the area served by that data closet.
6. Label patch panel terminations with the identical numbers used at the outlets.
7. Label both ends of each cabling run within 6 inches of termination points with Panduit Pan-Ty marker and flag ties, a label machine, or approved equal.
8. Label the room end of the cable with the data closet identification number (closet number and jack number) and label the data closet end of the cable with the room jack number (room number, voice and data jack number).
9. Whenever possible, cross connect riser pairs shall be run sequentially.

### **3.3 COPPER CABLE TESTING**

- A. Testing of all copper wiring shall be performed prior to system cutover. All jacks shall be landed before testing.
- B. Cables shall be tested for all Category 6A 100% Channel parameters using the specified level IV or V tester. Test all Category 6A Channel parameters, including attenuation, NEXT, PS NEXT, FEXT, ELFEXT, return loss, and delay skew.
- C. Patch cord, workstation cord, and cable lengths shall be recorded as part of the testing.
- D. Faults shall be corrected and retested.
- E. Test information along with manufacturer and model number of test equipment shall be recorded and provided to Owner as part of the project Telecommunications Manual.
- F. Provide proof of factory calibration of test meter within 6 months of the beginning of testing.
- G. The “\* pass” option on the test meter must be set to the “on” state. The “\* pass” symbol indicates a channel that is within 1 db of failing.
- H. Provide test data in electronic format with corresponding software for viewing of testing documentation on CD-ROM provided from the test meter. Contractor shall provide one CD-ROM to Owner and one to Engineer.
- I. Provide all cross connect information (X-Conn) to COR.

#### **1.14 GENERAL FIBER OPTIC TEST REQUIREMENTS: N/A**

#### **1.15 FIBER TEST PROCEDURES: N/A**

#### **1.16 FIBER TRANSMISSION LOSS TEST REPORT: N/A**

---END---

**SECTION 27 51 16**  
**PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS**

**PART 1 - GENERAL**

**1.1 SECTION SUMMARY**

- A. Work covered by this document includes design, engineering, labor, material, products, guaranty, training and services for, and incidental to, the complete installation of a new and fully operating National Fire Protection Association (NFPA) Listed Emergency/Public Safety Public Address and Mass Notification communication (PA) system as detailed herein.
- B. Work shall be complete, tested, labeled, certified and ready for operation
- C. The existing public address system will be expanded. Existing speakers shall be relocated as indicated on the drawings.

**1.2 RELATED SECTIONS**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below)
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- E. Section 26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
- F. Section 27 05 11, REQUIREMENTS FOR TELECOMMUNICATIONS
- G. Section 27 12 00, TELECOMMUNICATIONS CABLING EXPANSION

**1.3 DEFINITIONS**

- A. Provide: Design, engineer, furnish, install, connect complete, test, certify and guarantee.
- B. Work: Materials furnished and completely installed.
- C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.

#### 1.4 REFERENCES

A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:

1. United States Federal Law/Codes:

a. Departments of:

1) CFR, Title 15 - Department of Commerce, Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the:

a) Chapter II, National Institute of Standards Technology (NIST - formerly the National Bureau of Standards). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops - Federal Information Processing Standards Publication (FIPS) 140-2-Security Requirements for Cryptographic Modules.

b) Chapter XXIII, National Telecommunications and Information Administration (NTIA - aka 'Red Book') Chapter 7.8/9 Federal communications Commission (FCC) Title 47 (CFR), Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions and Locations.

2) CFR, Title 29, Department of Labor, Chapter XVII - Occupational Safety and Health Administration (OSHA), Part 1910 - Occupational Safety and Health Standard:

a) Subpart 7 - Definition and requirements for a National Recognized Testing Laboratory (NRTL - 15 Laboratory's, for complete list, contact

[http://www.osha.gov/dts/otpca/nrtl/faq\\_nrtl.html](http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html))

(1) Underwriter's Laboratories (UL):

65	Standard for Wired Cabinets.
468	Standard for Grounding and Bonding Equipment.
1449	Standard for Transient Voltage Surge

	Suppressors.
1069	Hospital Signaling and Nurse Call Equipment.
60950-1/2	Information Technology Equipment - Safety.

- (2) Canadian Standards Association (CSA): same tests as for UL.
- (3) Communications Certifications Laboratory (CCL): same tests as for UL.
- (4) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory [ETL]): Same tests as for UL.
- b) Subpart 35, Compliance with NFPA 101, Life Safety Code.
- c) Subpart 36, Design and construction requirements for exit routes.
- d) Subpart 268, Telecommunications.
- e) Subpart 305, Wiring methods, components, and equipment for general use.
- 3) Title 42, CFC, Department of Health, Chapter IV Health and Human Services, Subpart 1395(a)(b) Joint Commission on Accreditation of Healthcare Organizations (JCAHO) "a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:" All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
- 4) All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
- 5) CFR, Title 47 - Telecommunications, FCC: Part 15 - Restrictions of use for Part 15 listed Radio Equipment in Safety of Life/Emergency Functions/Equipment/Locations (also see CFR, Title 15 - Department of Commerce, Chapter XXIII - NTIA).
- 6) Public Law No. 100-527, Department of Veterans Affairs:
  - a) Office of Telecommunications:
    - (1) Handbook 6100, Telecommunications.
  - b) Office of Cyber and Information Security (OCIS):
    - (1) Handbook 6500, Information Security Program.

(2) Wireless and Handheld Device Security Guideline Version  
 3.2, August 15, 2005.

c) Spectrum Management FCC and NTIA Radio Frequency Compliance  
 and Licensing Program.

2. National Codes:

- a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.
- b. American National Standards Institute/Electronic Industries Association and Telecommunications Industry Association (ANSI/EIA/TIA):

568-B	Commercial Building Telecommunications Wiring Standards:
569	Commercial Building Standard for Telecommunications Pathways and Spaces.
606	Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
REC 127-49	Power Supplies.
RS 27	Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.

c. Institute of Electrical and Electronics Engineers (IEEE):

SO/TR 21730:2007	Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
0739- 5175/08/\$25. 00©2008IEEE	Medical Grade - Mission Critical - Wireless Networks.
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

d. NFPA:

70	National Electrical Code (current date of issue) - Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
99	Healthcare Facilities.
101	Life Safety Code.

3. State Hospital Code(s).

4. Local Codes.

#### **1.5 QUALIFICATIONS**

- A. The OEM shall have had experience with 3 or more installations of Public Address Systems of comparable size and complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least 1 year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.
- B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of 3 years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the system. This documentation, along with the system Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- C. The Contractor's Communications Technicians assigned to the system shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the system. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the COR before being allowed to commence work on the system.
- D. Applicable national, state and local licenses.
- E. Certificate of successful completion of OEM's installation/training school for installing technicians of the equipment being proposed.



#### **1.6 CODES AND PERMITS**

- A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the Owner.
- B. The Contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.

#### **1.7 SCHEDULING**

- A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.
- B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The owner will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

#### **1.8 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS**

- A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.
- B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.
- C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (0050P3B - herein after referred to as 0050P3B) will not review any submittal that does not have this list.
- D. Provide four copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C and D, at a minimum

for compliance review as described herein where each responsible individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).

**1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)**

- A. Throughout progress of the work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- B. The floor plans shall be marked in pen to include the following:
  - 1. All device locations with labels.
  - 2. Conduit locations.
  - 3. Head-end equipment and specific location.
  - 4. Wiring diagram.
  - 5. Labeling and administration documentation.
  - 6. Warranty certificate.
  - 7. System test results.

**1.10 USE OF THE SITE**

- A. Use of the site shall be at the GC's direction.
- B. Coordinate with the GC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the GC and their sub-contractors.
- D. Access to buildings wherein the work is performed shall be directed by the GC.

**1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.
- C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.
- D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

**1.12 PROJECT CLOSE-OUT**

- A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.
- B. Before the project closeout date, the Contractor shall submit:

1. Warranty certificate.
  2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
  3. Project record documents.
  4. Instruction manuals and software that is a part of the system.
- C. Contractor shall submit written notice that:
1. Contract Documents have been reviewed.
  2. Project has been inspected for compliance with contract.
  3. Work has been completed in accordance with the contract

## **PART 2 - PRODUCTS AND FUNCTIONAL REQUIREMENTS**

### **2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS**

- A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions. Utilize existing system components when possible. Devices damaged during demolition shall be replaced.
- B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.
- C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

### **2.2 SYSTEM DESCRIPTION**

- A. System hardware shall consist of components required for the expansion of the existing public address communications network comprised of amplifiers, speakers, wiring and other options such as, sub zoning in addition to "all call" functions, computer interfaces, printer interfaces and wireless network interfaces, (when specifically approved by 0050P3B and VA Headquarters Spectrum Management 0050P2B - herein after referred to as 0050P2B) as shown on drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse/patient communications network.

- B. The Public Address System (PAS) Head End Equipment is located in Telecommunications room BH-111. The PAS shall cover remodeled Hybrid OR scrub room. The PAS shall provide zoned, one-way voice paging through distributed, ceiling mounted loudspeakers. Voice input into the PAS shall be by zone using the telephone system. The Nurse Call/Code Blue System may interface the PAS system when specifically approved by VA Headquarters Spectrum Management 0050P3B during the project approval process prior to contract bidding.
- D. The PAS System is defined as an Emergency Communications Systems by NFPA and VA elevates it to Life Safety Communications System when carrying Code Blue signal and so evaluated by JCAHCO. Therefore, the system shall have a minimum of 2 remote enunciation points in order to satisfy NFPA's Life Safety Code 101.
1. These functions shall be the minimum required of the PAS system:
    - a. The Microphone Control Console locations shall be fully manned as long as the Facility is in operation.
    - b. One global (aka "all call") hard wired zone shall be provided that connects to every system speaker.
  2. The PAS shall allow voice pages to be made within a single zone, across programmed multiple zones or a global page (all zones) by using preset codes entered into the keypad of any telephone attached to the PBX.
- E. The PAS shall interface with any existing paging system so that a global page (aka "all call" page) is communicated to the existing paging system and the new PAS of this project. Arrangements for interconnection of the PAS and the telephone system(s) shall be coordinated with the owner and the PBX provider.
- F. Each PAS system shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. light bulbs, wires, contact switch connections, master control stations, wall stations, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault

alarm signal shall be initiated at the nurse control station and all remote locations.

- G. When the PAS system is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, Nurse Call, radio raging, wireless systems, etc) the connection point shall meet the following minimum requirements for each hard wired connection (note each wireless system connection must be approved prior to contract bid by VA Headquarters Spectrum Management 0050P3B and 0050P2B):

1. UL 60950-1/2.
2. FIPS 142.
3. FCC Part 15 Listed Radio Equipment is not allowed.

- H. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.

## **2.3 MANUFACTURERS**

- A. The products specified shall be new, UL Listed, and produced by OEM manufacturer of record.
- B. The following equipment items are the salient requirements of VA to provide an acceptable system described herein.

## **2.4 TELEPHONE INTERFACE EQUIPMENT (EXISTING)**

## **2.5 HEAD-END EQUIPMENT (EXISTING)**

- A. Existing head end equipment is located in telecommunications room BH-111.

## **2.6 AMPLIFIER EQUIPMENT (EXISTING)**

- A. Existing amplifier equipment is located in telecommunications room 2T-102.

## **2.7 SYSTEM SPEAKERS**

- A. Ceiling Cone-Type:
1. Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.
  2. Frequency Response: Within plus or minus 3 dB from 70 to 15,000 Hz.
  3. Minimum Dispersion Angle: 100 degrees.
  4. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
  5. Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch steel and whole assembly

- rust proofed and factory primed; complete with mounting assembly and suitable for surface ceiling, flush ceiling, pendant or wall mounting; with relief of back pressure.
6. Baffle: For flush speakers, minimum thickness of 0.032-inch aluminum with textured white finish. Completely fill the baffle with fiberglass.
  7. Vandal-Proof, High-Strength Baffle: For flush-mounted speakers, self-aging cast aluminum with tensile strength of 44,000 psi, 0.025-inch minimum thickness; countersunk heat-treated alloy mounting screws; and textured white epoxy finish.
  8. Size: 8 inches with 1-inch voice coil and minimum 5-oz. ceramic magnet.
  9. Have a minimum of 2 safety wires installed to a solid surface or use a flexible conduit from ceiling/wall back box to the speaker back box.
  10. The speakers and mounting shall be self contained and wall mounted with flush back box at a minimum of 10 meter intervals and shall match (or contrast with, at the direction of the COR the color of the adjacent surfaces.
  11. Provide one spare speaker, mount, and back box for each 50 speakers or portion thereof.

## **2.8 SYSTEM CABLES**

- A. Refer to OFM approved Construction Specification 27 12 00, TELECOMMUNICATIONS CABLING EXPANSION for specific installation and testing requirements.
- B. Line Level Audio and Microphone Cable:
  1. Line level audio and microphone cable for inside racks and conduit.
  2. Shielded, twisted pair Minimum 22AWG, stranded conductors and 24AWG drain wire with overall jacket.
- C. Speaker Level Audio Cable (70v):
  1. For use with 70-volt speaker circuits.
  2. 18AWG stranded pair, minimum.
- D. Speaker Level Audio Cable, Plenum Rated (70v):
  1. For use with 70-volt speaker circuits.
  2. 18AWG stranded pair, minimum.
- E. All cabling shall be plenum rated.

- F. Provide 1 spare 1,000 foot roll of approved system (not microphone) cable only.

## **2.9 RACEWAYS**

- A. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Each raceway that is open top, shall be: UL certified for telecommunications systems, partitioned with metal partitions in order to comply with NEC Parts 517 and 800 to "mechanically separate telecommunications systems of different service, protect the installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface "drop" type conduit cable feeds.
- C. Intercommunication System cable infrastructure: EMT or in J-hooks above accessible ceilings, 24 inches on center.
- D. Junction boxes shall be not less than 2-1/2 inches deep and 6 inches wide by 6 inches long.
- E. Flexible metal conduit is prohibited unless specifically approved by 0050P3B.

## **2.10 CONDUIT SLEEVES**

- A. The Engineer has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings, and has instructed the electrician to provide the sleeves as shown on the drawings.
- B. While the sleeves shown on the drawings will be provided by others, the contractor is responsible for installing conduit sleeves and fireproofing where necessary. It is often the case, that due to field conditions, the nurse-call cable may have to be installed through an alternate route. Any conduit sleeves required due to field conditions or those omitted by the engineer shall be provided by the cabling contractor.

## **2.11 UNINTERRUPTIBLE POWER SUPPLY (UPS) (NOT USED - EXISTING)**

## **PART 3 - EXECUTION**

### **3.1 PROJECT MANAGEMENT**

- A. Assign a single project manager to this project who will serve as the point of contact for the Owner, the General Contractor, and the Engineer.
- B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the general contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.
- C. Contact the Office of Telecommunications, Special Communications Team (0050P3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

### **3.2 COORDINATION WITH OTHER TRADES**

- A. Coordinate with the cabling contractor the location of the faceplate and the faceplate opening for the MATV backbox.
- B. Coordinate with the cabling contractor the location of MATV equipment in the Telecommunications Closets.
- C. Before beginning work, verify the location, quantity, size and access for the following:
  - Isolated ground AC power circuits provided for systems.
  - Primary, emergency and extra auxiliary AC power generator requirements.
  - Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
  - System components installed by others.
  - Overhead supports and rigging hardware installed by others.
- D. Immediately notify the Owner, General Contractor and Consultant in writing of any discrepancies.

### **3.3 INSTALLATION**

- A. General:
  - 1. Execute work in accordance with National, State and local codes, regulations and ordinances.
  - 2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor



- will be fully responsible for protection of his work during the construction phase up until final acceptance by the Owner.
3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
  4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc:
    - a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
    - b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
    - c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
    - d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
  5. Locate overhead ceiling-mounted loudspeakers as shown on drawings, with minor changes not to exceed 12" in any direction:
    - a. Mount transformers securely to speaker brackets or enclosures using screws. Adjust torsion springs as needed to securely support speaker assembly.
    - b. Speaker back boxes shall be completely filled with fiberglass insulation.
    - c. Seal cone speakers to their enclosures to prevent air passing from one side of the speaker to the other.
  6. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and 0050P3B.
  7. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommets in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
- B. Wiring Practice: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 12

00, TELECOMMUNICATIONS CABLING EXPANSION, the following additional practices shall be adhered to:

1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Wiring shall be classified according to the following low voltage signal types:
  - a. Balanced microphone level audio (below -20dBm) or Balanced line level audio (-20dBm to +30dBm)
  - b. 70V loudspeaker level audio.
  - c. Low voltage DC control or power (less than 48VDC)
4. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least four inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
7. Replace the entire length of the run of any wire or cable that is damaged or abraided during installation. There are no acceptable methods of repairing damaged or abraided wiring.
8. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
9. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
10. Do not use tape-based or glue-based cable anchors.
11. Ground shields and drain wires as indicated by the drawings.
12. Field wiring entering equipment racks shall be terminated as follows:

- a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
  - b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see "Products"). Provide 15percent spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
  - c. If specified terminal blocks are not designed for rack mounting, utilize 3/4" plywood or 1/8" thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
  - d. Employ permanent strain relief for any cable with an outside diameter of 1" or greater.
13. Use only balanced audio circuits unless noted otherwise
14. Make all connections as follows:
- a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
  - b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
  - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
  - d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
- D. Cable Installation: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:
1. Support cable on maximum 4'-0" centers. Acceptable means of cable support are cable tray, j-hooks, and bridal rings. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
  2. Run cables parallel to walls.
  3. Install maximum of 10 cables in a single row of J-hooks. Provide necessary rows of J-hooks as required by the number of cables.

4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2'-0" clearance from all shielded electrical apparatus.
5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the Owner.
6. Ends of cables shall be properly terminated on both ends per industry and OEM's recommendations.
7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
8. Cover the end of the overall jacket with a 1" (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2" (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2" (minimum) past the Heat-shrink and serve as indicated below.
9. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing ¼" past the end of unused wires, fold back over jacket and secure with cable tie.
10. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
11. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
12. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
13. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
14. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
15. Separation of Wires: (REFER TO RACEWAY INSTALLATION) Separate speaker-microphone, line-level, speaker-level, and power wiring

runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

16. Serve all cables as follows:

- a. Cover the end of the overall jacket with a 1" (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2" (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield and drain wires 2" (minimum) past the Heat-shrink and serve as indicated below.
- b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing ¼" past the end of unused wires, fold back over jacket and secure with cable tie.
- c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.

E. Labeling:

1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
2. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
6. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.

7. Ensure each OEM supplied equipment has appropriate UL Labels/Marks for the service the equipment is performed permanently attached/marked. Equipment installed not bearing these UL marks will not be allowed to be part of the system. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

#### **3.4 PROTECTION OF NETWORK DEVICES (NOT USED)**

#### **3.5 CLEANING AND PATCHING**

- A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.
- B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.
- C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the work or to make its parts fit together properly.
- D. The Contractor shall not damage or endanger a portion of the work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate Contractor, the Contractor's consent to cutting or otherwise altering the work.
- E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

#### **3.6 FIREPROOFING**

- A. Where MATV cables penetrate fire rated walls, floors and ceilings, fireproof the opening.
- B. Provide conduit sleeves (if not already provided by Electrical Contractor) for cables that penetrate fire rated walls. After the cabling installation is complete, install fire proofing material in and

around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.

- C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.

### **3.7 GROUNDING**

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, commonmode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 26, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- D. Do not use "3rd or 4th" wire internal electrical system conductors for ground.
- E. Do not connect system ground to the building's external lightning protection system.
- F. Do not "mix grounds" of different systems.

## **PART 4 - TESTING**

### **4.1 SYSTEM CLASSIFICATION**

The PAS System is NFPA listed as an "Emergency and Public Safety" Communications system. Where Code Blue signals are transmitted, that listing is elevated to "Life Support." Therefore, the following testing provisions are the minimum to be performed and provided by the contractor and OEM.

### **4.2 PROOF OF PERFORMANCE TESTING**

- A. Pretesting:
  - 1. Upon completing installation of the PAS System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
  - 2. Pretesting Procedure:
    - a. During the system pretest the Contractor shall verify (utilizing approved test equipment) that the system is fully operational and meets all the system performance requirements of this standard.
    - b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc., are present. At a

minimum, each of the following locations shall be fully pre-tested:

- 1) PA Control Stations.
  - 2) Zone Equipment/Systems.
  - 3) Sub-Zone Equipment/Systems.
  - 4) Local and Remote Enunciation Panels.
  - 5) All Networked locations.
  - 6) System interface locations (i.e. TELCO, two way radio, etc.).
  - 7) System trouble reporting.
  - 8) System Electrical Supervision.
  - 9) UPS operation.
3. The Contractor shall provide four copies of the recorded system pretest measurements and the written certification that the system is ready for the formal acceptance test shall be submitted to the COR.

C. Acceptance Test:

1. After the system has been pre-tested and the Contractor has submitted the pretest results and certification to the COR, then the Contractor shall schedule an acceptance test date and give the COR 30 days written notice prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative and an OEM certified representative. The system shall be tested utilizing the approved test equipment to certify proof of performance and Emergency and Public Safety compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed system does comply with all requirements of this specification under operating conditions. The system shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the system that precludes completion of system testing, and which cannot be repaired in 4 hours, shall be cause for terminating the acceptance test of the system. Repeated



failures that result in a cumulative time of 8 hours to affect repairs shall cause the entire system to be declared unacceptable. Retesting of the entire system shall be rescheduled at the convenience of the Government.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

- a. The COR will tour all major areas where the system is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
- b. The system diagrams, record drawings, equipment manuals, pretest results shall be formally inventoried and reviewed.
- c. Failure of the system to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

- a. After the Physical and Mechanical Inspection, the central terminating and nurse call master control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this requirement.
- b. Following the central equipment test, a pillow speaker (or on board speaker) shall be connected to the central terminating and nurse call master control equipment's output tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
- c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last intersectional, room, and bed dome light in each leg to verify that the nurse call distribution system meets all system performance standards.
- d. The red system and volume stepper switches shall be checked to insure proper operation of the pillow speaker, the volume stepper and the red system (if installed).
- e. Additionally, each installed head end equipment, microphone console, amplifier, mixer, distributed speaker/amplifier, monitor

speaker, telephone interface, power supply and remote amplifiers shall be checked insuring they meet the requirements of this specification.

- f. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system. The typical functions are: "all call," three sub-zoned, minimum of 10 minutes of UPS operation, electrical supervision, trouble panel, corridor speakers and audio paging.
  - g. Individual Item Test: The Government Representative will select individual items of equipment for detailed proof of performance testing until 100 percent of the system has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.
3. Test Conclusion:
- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the COR. Any retesting to comply with these specifications will be done at the Contractor's expense.
  - b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be born by the Contractor.

E. Acceptable Test Equipment

- 1. The test equipment shall furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
  - a. Spectrum Analyzer.
  - b. Signal Level Meter.
  - c. Volt-Ohm Meter.
  - d. Sound Pressure Level (SPL) Meter.
  - e. Oscilloscope.
  - f. Random Noise Generator.
  - g. Audio Amplifier with External Speaker.

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PROJECT NO. 618-14-103  
Renovate to Create Hybrid OR, Phase 1  
100% CD Issue  
11-19-2013

**SECTION 27 52 23**  
**NURSE CALL/CODE BLUE SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This document specifies the furnishing, installing, and testing of a complete and operating Audio - Visual, Visual Only, and Code One (Blue) Nurse Call here-in-after referred to as "the System", and associated equipment to be installed in the VA Medical Center, here-in-after referred to as "the Facility".
  1. The System shall be capable of interfacing with the two-way radio system and networking more than one nurse call control unit.
  2. The System shall be capable of interfacing with the facility's telephone system and networking more than one nurse call control unit.
- B. The System is microprocessor based and includes: central terminal assemblies; nurse control master stations; code blue, and emergency stations; dome lights; combiners, traps and filters; audio distribution amplifiers; uninterruptible power supplies (UPS); conduit, cable duct, and/or cable tray; and necessary passive devices such as, cable, wire, and connectors, cordsets, and push-buttons.
- B. The System shall be delivered free of engineering, manufacturing, installation, and operating defects. It shall be engineered and installed for ease of operation, maintenance, and testing.
- C. Updates, additions, and revisions to the existing nurse call System shall be designed and installed so that the installation, interfacing, integration, combining, and/or consolidation of equipment actually employed does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, audio or video hum bars, transients, ghosting, etc.
- D. The System is defined as an Emergency Critical Care Communication System and, the Code One (Blue) System is defined as an Emergency Critical Care Life Support Communication System by the National Fire Protection Association (NFPA). Therefore, its installation and operation shall adhere to all appropriate National and/or Government Local Life Safety and/or Support Codes, whichever are the more stringent for this Facility. Additionally, the original equipment manufacturer's (OEM) recommendations and guidelines shall be followed. The OEM and Contractor shall ensure that all management, sales, engineering, and installation personnel have read and understand the requirements of this specification before the System is designed, engineered, delivered, and provided.
- E. The VA COR is the approving authority for all contractual and operational changes to the System. The Contractor is cautioned to obtain in writing, approvals for System changes relating to the published contract specifications and drawings, from the COR before proceeding with any proposed change.
- F. Equipment Standards and Product Testing:

1. All equipment and materials (other than specific nurse call or code one (blue) equipment items) used in providing the System shall be listed, labeled and certified by UL or a nationally recognized testing laboratory where such standards have been established for the utilized items. Such listing and labeling shall warrant that the equipment has been tested in accordance with, and conforms to the specified standards.
2. The provided active and passive nurse call and code one (blue) equipment required by the system design and approved technical submittal must conform with each UL standard in effect for the equipment, as of the date the technical submittal (or the date when the COR approved system equipment necessary to be replaced) was technically reviewed and approved by the VA. Where a UL standard is in existence for equipment to be used in completion of this contract, a test must be conducted to certify the equipment meet the published UL standard. This test must be conducted by UL that makes periodic inspections of the production of nurse call equipment. The Contractor's technical submittal shall include UL certification and/or documents supplied by the testing laboratory that indicate each piece of equipment to be furnished conforms to UL standards, where such standards exist:
3. Each item of equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards.
4. At a minimum, the entire system shall meet or exceed UL 1069 Standard and be listed so in UL's published literature. The Contractor shall provide a copy of the entire UL 1069 published listing as a part of the technical submittal.

System Performance: The total system shall meet the following performance standards:Function	Characteristics
Audio Gain	10 decibel (dB) minimum, Sound Pressure Level (SPL)
Signal to Noise (S/N) Ratio	35 dB minimum

#### 1.2 RELATED WORK

- A. Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Specification Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Specification Section 27 12 00, TELECOMMUNICATIONS CABLING EXPANSION.

E. Specification Section 26 27 26, WIRING DEVICES.

F. Specification Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

### 1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of the System's submittal is technically approved by the VA, shall be enforced.

B. National Fire Protection Association (NFPA):

70	National Electrical Code (NEC)
77	RECOMMENDED PRACTICE ON STATIC ELECTRICITY
99	Standard for Health Care Facilities
101	Life Safety Code

C. Underwriters Laboratories, Inc. (UL):

65	Standard for Wired Cabinets
467	Standard for Grounding and Bonding Equipment
1069	Standard for Hospital Signaling and Nurse Call Equipment
1410	Standard for Television Receivers and Video Products
1778	Standard for Uninterruptable Power Supply

D. U.S. National Archives and Records Administration (NARA):

47 CFR 15	Radio Frequency Devices
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E. Electronic Industries/Telecommunications Industries Associations (EIA/TIA):

568	Commercial Building Telecommunications Wiring Standard
569	Commercial Building Telecommunications Pathways and Spaces Standard

606	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
607	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
RS-270	Tools, Crimping, Solderless Wiring Devices Recommended Procedures for User Certification

F. Joint Commission on Accreditation of Health Care Organization (JCAHCO): Comprehensive Accreditation Manual for Hospitals

G. National and/or Government Life Safety Codes(s): The more stringent of each listed code.

#### **1.4 QUALITY ASSURANCE**

- A. The authorized representative of the System's OEM shall be responsible for the design, satisfactory total operation of the System, and its certification.
- B. The OEM shall meet the minimum requirements identified in paragraph 2.1.A. Additionally, the OEM shall have had experience with three or more installations of systems of comparable size and complexity as regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Each of these installations shall have been in successful operation for at least three years after final acceptance by the user. These installations shall be provided as a part of the submittal identified in paragraph 1.5.
- C. The System Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- D. The Contractor's Communications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the COR before being allowed to commence work on the System.

#### **1.5 SUBMITTALS**

- A. Provide submittals in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The COR shall retain one copy for review and approval.

1. If the submittal is approved the COR shall retain one copy for Official Records and return three (3) copies to the Contractor.
  2. If the submittal is disapproved, three (3) copies will be returned to the Contractor with written explanation attached indicating the areas the submittal deviated from the System specifications. The COR shall retain one copy for Official Records.
- B. The submittal shall be separated into sections for each sub-system and shall contain the following:
1. Title page to include:
    - a. Facility name
    - a. VA Project Name
    - c. Contractor's name, address, and telephone (including FAX) numbers
    - d. Date of Submittal
    - e. VA Project Number
  2. A list containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:
    - a. Facility location and name
    - b. Owner's or User's name, address, and telephone (including FAX) numbers
    - c. Date of Project Start and Date of Final Acceptance by Owner
    - d. System Project Number
    - e. Brief (three paragraphs minimum) description of each system's function, operation and installation
  3. Narrative Description of the system as it is expected to be installed.
  4. A list of the equipment to be furnished. The quantity, make and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the System.

The following are the minimum equipment required by the System:

QUANTITY	UNIT
As required	Central Terminal Equipment and Cabinet
As required	Power Amplifiers
As required	Nurse Control Master Station
As required	Duty Station
As required	Corridor Dome Lights
As required	Intersectional Dome Lights



As required	Code One (Blue) Station
As required	Remote Annunciator Panel
As required	Wires and Cables
As required	General Station Connectors
As required	Emergency Station
As required	Push-buttons
1 ea.	Installation Kit
As identified	Separate List of each Equipment Spare(s)

5. Central terminal cabinet layout drawing, as it is expected to be installed.
6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
7. Engineering drawings of the System, with information to determine compliance with contract drawings and specifications.
8. List of test equipment per paragraph 1.5.C.
9. Letter certifying that the Contractor understands the requirements of the SAMPLES paragraph 1.5.D.
10. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning tests.

C. Test Equipment List:

1. The Contractor is responsible for furnishing all test equipment required to test the System in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the System. The Contractor shall furnish test equipment of accuracy better than the parameters to be tested.
2. The test equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
  - a. Spectrum Analyzer
  - b. Signal Level Meter
  - c. Volt-Ohm Meter
  - d. Sound Pressure Level (SPL) Meter
  - e. Sound Pressure Level (SPL) Calibrator
  - f. Random Noise Generator
  - g. Audio Amplifier with External Speaker

D. A sample of each of the following items shall be furnished to the COR for approval prior to installation.

1. 610 mm (2 foot) section of each cable to be used with connectors installed and OEM cable sweep compliance and/or certification tags as specified in paragraph 2.3.F.
2. Back boxes for the nurse call patient stations, dome lights, staff stations, duty stations, annunciator panels, and junction boxes.
3. Cover plates used for patient stations, staff stations duty stations, annunciator panels, emergency stations, and code one (blue).
4. UPS equipment (if required by system design).
5. Electrical supervision panels for code one (blue) sub-systems.

E. Certifications

1. Submit written certification from the OEM indicating that the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL 1066, this specification, and JCAHCO requirements and the instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA will not approve any submittal without this certification.
3. Preacceptance Certification: This certification shall be made in accordance with the test procedure paragraph 3.2.B.

F. Equipment Manuals: Ten (10) working days prior to the scheduled acceptance test, the Contractor shall deliver four (4) complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the COR. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.

G. Record Wiring Diagrams:

1. Ten (10) working days prior to the acceptance test, the Contractor shall four (4) complete sets of the record wiring diagrams of the System to the COR. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, equipment and room/area locations.
2. The record wiring diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility's current operating version of Computer Aided Drafting (AutoCAD) system. The COR shall verify and inform the Contractor of the current version of AutoCAD being used by the Facility.

H. Ten (10) days prior to the start of the intermediate test, provide a typewritten detailed description of the System testing plan that meets

this specification's performance standards as indicated in paragraph 2.1.C including illustrations and utilizes the test equipment specified in paragraph 1.5.C. The test plan will need to be evaluated and approved by the COR before intermediate testing begins.

- I. Provide two (2) copies of a OEM developed training video tape presentation (reference paragraph 3.3.B) for evaluation and approval by the COR.
- J. Provide a typewritten document that details the complete record program in memory for all associated station assignments. PART 2 - PRODUCTS

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT AND MATERIALS**

- A. Manufacturer: Rauland Responder 5.
  - 1. Substitutions: Not permitted.
- B. System Requirements:
  - 1. The System shall receive the specified system signals and shall process and distribute them to the designated outlet, control and/or remote locations shown on the drawings. The System shall be designed to minimize cross talk, background processor noise and other signal interference.
  - 2. The central control equipment shall be provided in the central equipment terminal cabinet ensuring that test port(s) is provided for access to each system function without the need to disconnect distribution cables or equipment.
  - 3. The System shall be capable of interfacing with the two way radio system and networking more than one nurse call control units. These functions and connections must be specifically approved, in writing, by the COR during the specification, and technical submittal approval processes.
  - 4. The System shall be capable of interfacing with the telephone system and networking more than one nurse call control unit. These functions and connections must be specifically approved in writing by the COR during the technical submittal approval process.
  - 5. Each floor or ward distribution system shall be a "buss" design where each room's nurse call equipment is fed from centrally located lateral trunk line cables. Each signal closet mounted terminal cabinet shall be capable of connection to vertical trunk line riser cables in the associated signal closet and as shown on the drawings and recommended by the OEM.
  - 6. Each floor or ward distribution system shall be installed in conduit.
  - 7. The Contractor shall provide verification in writing that the type wire/cable being furnished and installed is recommended and approved by the OEM and will provide a total system free of defects.
  - 8. Central Terminal Cabinet Location: The cabinet shall be provided, protected, and located at the most central distribution system

signal closet location to insure optimum origination, reception and control of all system signals. Each cabinet shall be provided with a internal active 120 Volts Alternating Current (VAC) quad receptacles connected by conduit to the Facility's Critical Branch Emergency Power Distribution Panel as shown on plans or if not shown on plans consult with COR regarding a suitable circuit location, prior to bidding. Each cabinet shall be installed to allow working clearances per NEC Article 110, paragraph 110.26 and as recommended by the equipment manufacturer. Each cabinet shall be provided, as required to meet the single audio and data channel requirements, and system performance standards.

9. Central Terminal Cabinet and Master Control Station Selection:

- a. The cabinet(s) shall be located in IT Closet 2T-104 and will be provided as part of the Renovate to Create Hybrid OR - Phase I project by the Phase I contractor.
- b. The master control station(s) shall be provided and protected in the nurses stations as shown on the drawings.

C. Visual Nurse Call System:

1. A System shall be provided, protected and located in the VA Medical Center Hybrid OR.
2. The System shall also report to a nurse call master station at the PACU central stations in 2M-110 and 2M-111.

D. Code One (Blue) System:

1. The code one (blue) system shall consist of a code one (blue) master control station with associated alarm and control units, bedside stations, duty stations, dome lights, central equipment cabinet(s), and remote annunciator panels in the "on-call" room(s) and the telephone switchboard room. Local code one (blue) annunciation shall be provided at the associated nurses station, duty room(s), and staff room(s).
3. Each code one (blue) system shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. dome light bulbs [each light will be considered supervised if they use any one or a combination of Underwriters Laboratory, Inc. (UL) approved electrical supervision alternates, as identified in UL-1069, 1992 revision], wires, contact switch connections, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the nurse control station and all remote locations.
4. Provide the System with the following minimum equipment:
  - a. Code one (blue) alarm unit with push-button/switch reset device, code one amber (or other like Life Safety approved) lamp, silencing device, test/fault alarm push-button/switch with an

alarm lamp. The unit is to be installed at the nurse or master control station.

- b. Local and remote annunciator panels with visual annunciators which will visually identify each unit placing a call, and a silencing device.
  - c. Code one (blue) nurse call master stations, local, and remote annunciator panels shall be capable of displaying each area that has a code one (blue) system.
5. The System shall provide the following minimum operational functions that compliments and operates in conjunction with the minimum electrical or electronic supervision requirements identified in paragraph 2.H.3:
- a. Code one (blue) calls shall be cancelable at the calling station only. The code one (blue) or nurse call master station shall not have the ability to cancel code one (blue) calls.
  - b. Each code one (blue) system shall be able to receive audio calls.
  - c. Calls placed from any code one (blue) station shall generate emergency type audible and visual signals at each associated nurse control and duty station, and all local and remote annunciator panels.
  - d. Activating the silencing device at any location, while a code one (blue) call or system fault is occurring shall mute the audible signals at the alarm location. The audible alarm shall regenerate at the end of the selected time-out period until the call or fault is corrected. The visual signals shall continue until the call is canceled and/or a fault is corrected. When the fault is corrected, all signals generated by the fault shall automatically cease, returning the System to a standby status. Audible signals shall be regenerated in any local or remote annunciator panel that is in the silence mode, in the event an additional code (blue) one call is placed in any code one (blue) system. The additional code one (blue) call shall also generate visual signals at all annunciators to identify the location of the call.
6. It is permissible to utilize an audio visual microprocessor nurse call system for code one (blue) functions providing the System is designed and UL approved to function as an integrated nurse call and code one (blue) system that employs code one (blue) operational qualities as described herein for all system locations, and equipped with the following functions and capabilities, at a minimum:
- a. Must be able to generate audible and visual signals to code one (blue) duty stations, local and remote annunciating panels as specified herein for code one (blue) placed calls.
  - b. Possess built-in diagnostics to locate and service components.
  - c. Perform continuous electrical supervision circuitry as defined in herein for code one (blue) and associated nurses call functions.

E. General:

- 1. All equipment to be supplied under this specification shall be new and the current model of a standard product of an OEM of record. An

- OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
- a. Maintains a stock of replacement parts for the item submitted.
  - b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
  - c. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.
2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, that item of equipment shall meet or exceed the specification for that item of equipment.
  3. The Contractor shall provide written verification, to the COR that the type of wire/cable being provided is recommended and approved by the OEM. Cabling shall meet the interconnecting wiring requirements of UL 1069; and the requirements of NFPA 70 (NEC). The Contractor is responsible for providing the proper size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.
  4. The Nurse Call Contractor is responsible for interfacing Two-Way Radio Paging, and Telephone systems with the nurse call system. The Contractor shall continually employ interfacing methods that are approved by the OEM and VA. At a minimum, an acceptable interfacing method, requires not only a physical and mechanical connection but, a matching of signal, voltage and processing levels, with regard to signal quality and impedance. The interface point must adhere to all standards described herein for the full separation of Critical Care and Life Safety systems. The audio interface must be accomplished utilizing solid state switching. It is not acceptable to utilize the MATV/cable system for distribution and control of nurse call system signals and equipment.
  5. Active electronic component equipment shall consist of solid state components and be rated for continuous duty service in the areas where provided.
  6. All passive distribution equipment and cables shall meet or exceed - 80 dB radiation shielding specifications.
  7. All signaling and communication circuits shall be solid state except for audio switching relays.
  8. The System shall utilize microprocessor components for all signaling and programming circuits and functions. Program memory shall be non-volatile or protected from erasure from power outages for a minimum of five minutes.
  9. The System shall provide the continuous polling (not to be substituted for electrical supervision) of each station sequentially

to determine change of status and to assist in trouble shooting faults.

10. All voltages, except for the primary power to the power supply circuits, shall not exceed 30 VAC Root Mean Squared (RMS) or 41.2 V direct current (DC).
11. Color code all distribution wiring to conform to the Nurse Call Industry standard, EIA/TIA, and this document, whichever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance. Reference Specification Section 27 12 00, STRUCTURED CABLING.
12. Connect the System's primary input AC power to the Facility's Critical Branch of the Emergency AC Power Distribution System as shown on plans or if not shown on plans consult with COR regarding a suitable circuit location, prior to bidding.
13. All equipment shall function and operate normally from the furnished power source, and also, during input power fluctuations or loss of power for a minimum of 15 minutes.
14. Plug-in connectors shall be provided to connect all stations, except emergency stations and corridor lights. Emergency stations and corridor lights shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are an acceptable alternate as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts or solder type connections are unacceptable and will not be approved.
15. All equipment face plates utilized in the System shall be stainless steel, anodized aluminum or UL approved cycolac plastic that matches the equipment item it is installed. All faceplates shall be constructed of the same material throughout the facility.
16. All equipment trim plates utilized in the System shall be stainless steel, anodized aluminum or UL approved cycolac plastic that matches the equipment item and the areas where provided. Trim plates are not authorized to bear the UL label for the station unless specifically approved by UL. All trim plates shall be constructed of the same material throughout the facility.
17. Noise filters and surge protectors shall be provided for each equipment control cabinet, nurse call master station, local, and remote locations to ensure protection from input primary AC power surges and noise glitches are not induced into low voltage data circuits.
18. Passive and electronic components and cabling shall be provided under the OEM's recommendations and guidance, to prevent damage to any system equipment from electrostatic discharges of a minimum of 25,000 Volts, at a relative humidity of a maximum of 20 percent (%) or less. The Contractor shall detail in the technical submittal the method and equipment to be utilized to protect the system components from a minimum 25,000 Volt electrostatic discharge.

- F. Master Station Nurse Call and Code One (Blue) Equipment shall include, but not be limited to, the following:
1. Provide station, including monitor, computer processing unit (CPU), keyboard, mouse, and UPS when used ie. PACU cenral station rooms 2M-110 and 2M-111.
  2. One telephone type handset shall be provided per station.
  3. Provide one current (as of the technical acceptance date of the System by the VA) operational copy of system software (VA to retain right of ownership and to be provided future software upgrades at a negotiated cost). Provide one complete spare software copy including published and unpublished upgraded.
- G. Dome Lights:
1. Corridor dome lights shall be provided as shown on the drawings and identified in the equipment list. Provide one spare dome.
  2. Room dome lights shall be provided as shown on the drawings and identified in the equipment list. Provide one spare dome light.
  3. Code one (blue) dome lights shall be provided as shown on the drawings and identified in the equipment list. Provide one spare dome light.
- H. Local and Remote Annunciator Panel Equipment shall be provided in the locations shown on the drawings and identified in the equipment list. Provide one spare panel.
- I. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
Power Line Frequency	60 Hertz (Hz), $\pm 2.0$ Hz
Operating Temperature	0 to 50 degrees ( $^{\circ}$ ) Centigrade (C)
Humidity	80 %, minimum rating

## 2.2 CENTRAL TERMINAL ASSEMBLIES

- A. Equipment Cabinet:
1. Expand equipment cabinet installed by Hybrid OR Phase 1 contractor located in rom 2T-104.
  2. AC Power Surge Protector Strip(s):
    - a. The strip may be provided, in lieu of the required internal cabinet mounted quad AC outlet(s), with an outlet for each item of equipment and a minimum of four spare AC power outlets. Each



strip shall be mounted inside and at the rear of each equipment cabinet. The strip shall be self-contained in a metal enclosure with a maximum of 1.8 m (6 feet) connecting wire with three-prong plug. It is acceptable to connect it to one of the service outlets for the AC power line filter. Extension or "pig tail" non-protected cords from the system cabinet or rack to a system wall outlet is not authorized and shall not be allowed and if discovered shall be grounds to declare the entire system unacceptable and terminate all acceptance testing.

b. Technical Characteristics:

Power Capacity	20 Ampere (AMP), 120 VAC continuous duty
Wire Gauge	Three conductor, #12 American Wire Gauge (AWG) solid copper

3. AC Power Line Surge Protector and Filter:

- a. Provide each cabinet containing active electronic equipment shall be with a AC surge protector and filter. The protector and filter shall be housed in one single enclosure. The protector and filter shall provide instantaneous regulation of the AC input voltage and isolate and filter any noise present on the AC input line. It shall be mounted inside the cabinet and the cabinet's AC power strip (two strips maximum) may be connected to it.

b. Technical Characteristics:

Input Voltage Range	120 VAC $\pm$ 15%
Power Capacity	20 Amperes (AMP), 120 VAC
Voltage Output Regulation	$\pm$ 3.0%
Circuit Breaker	15 AMP, may be self contain
Noise Filtering	Greater than 45 dB
AC Outlets	Four duplex grounded types, minimum
Response Time	5 Nano Seconds (nS)
Surge Suppression	10,000 AMPS
Noise Suppression:	
Common	-40 dB

Differential	-45 dB
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B. Central Terminal Equipment:

1. Each sub-system (ward) shall be provided with separate central terminal equipment that will service no more than two nursing units or wards. Components of the central equipment shall be mounted on panels or standard EIA rack dimensions.
2. The provided sub-systems shall be balanced so that when the system volume level is adjusted to maximum, no pulsating noise or data noise is audible, when communicating between the nurse control station and the most distant patient bedside station.
3. Each power amplifier unit shall be provided with separate power overload protection circuits and shall provide self-limiting audio compression without distortion. The amplifiers shall have a common volume control for regulation of intercom audio for all associated stations. The amplifiers shall be adjusted/balanced to provide normal system audio levels between the master station and all remote locations when system audio levels are adjusted to approximately mid-range. Provide one spare amplifier circuit board and/or module.
4. Each provided cabinet shall conform to the spaces designated for installation. The width, height and depth dimensions of the central equipment cabinet shall be included with the equipment submittals.

C. Product: Rauland. Substitutions not permitted.

**2.3 EQUIPMENT SPECIFICATIONS**

A. Supervised Code Station/Staff Assist:

1. Two Tactile membrane call points with call-assurance LEDs.
3. Tactile membrane reset touchpoint.
4. Local Code Blue supervision.
5. Code Blue timer output.
6. Supervised by associated call station.
7. Product: Rauland 354015. Substitutions not permitted.
8. Optional antimicrobial Bio-seal to cover buttons and allow for easy disinfecting of the station
8. Provide clear button cover to protect against accidental code calls. Product Rauland 350008.

B. Corridor Door Dome Lights:

1. Provide light covers that are translucent and shall not deform, discolor or craze from heat or use of normal hospital cleaning agents.
2. Corridor door dome lights shall be provided for exam rooms, patient toilet rooms and shall contain sufficient lamps to permit distinguishing the following type placed calls:
  - a. Routine placed calls from bedside stations

- b. Routine and emergency calls from staff terminals.
  - c. Emergency placed calls from bath/toilet emergency stations, if the bedroom has such facilities
  - d. Emergency placed calls from bedside stations that are programmed in the emergency/priority mode
  - e. The visual signals for routine and emergency/priority placed calls shall be distinctly different from each other
  - f. Calls placed in the reminder/nurse aide function
- 3. Corridor dome lights shall be provided for congregate bath/toilet areas and shall contain one red lamp.
  - 4. Each dome light shall be mounted on a dual-gang back box, minimum. A trim plate constructed of stainless steel or a material similar to the dome light shall be provided to cover the back box opening and frame the cover plate.
  - 5. Product: Rauland 352000. Substitutions not permitted.
- C. Nurse Control Master Station: Each nurse control station shall be provided:
- 1. As an audiovisual type.
  - 2. As desk mounted: With 1.2 meters (4 feet) of interconnecting cable (from the central equipment to the master station) to allow for convenient placement of the nurse control station on the desktop.
  - 3. With the following features:
    - a. Microphone/speaker and telephone handset with a 910 mm (3 foot) coiled cord. The handset shall be able to conduct two-way voice communication between the nurse and the selected calling station. Lifting the handset shall mute the microphone/speaker.
    - b. Digital readout touch screen to visually announce the location of incoming calls placed in the System including room and bed number and priority of the call. Identify each calling station with an individual display, including separate displays for each patient sharing a dual bedside station. If a digital readout touch screen standard is not submitted or approved by the Facility during the project design phase, an alpha - numeric scheme shall be provided that identifies the: ward, room and bed (i.e. Ward 2a, Room 201, Bed A (or 1) shall read 2A201A -or- 2A201-1. Equivalent readouts are acceptable as long as the Facility approves the readout).
  - 1) Calls placed at emergency stations located in toilets and baths inside bedrooms shall be displayed for the bed closest to the nurse control station. Beds in multi-bed bedrooms shall be identified in a clock-wise pattern upon entering the bedroom.
  - 2) It shall display a minimum of four incoming calls. Additional placed calls shall be stored in order of placement and priority.

- c. Nurse follower function. All calls placed in the System shall be visually or audibly announced at the selected bedside stations when selecting the nurse follower mode of operation and the bedside stations to be visited. It is acceptable for the nurse follower mode to be activated inside rooms containing bedside stations.
- d. Automatic answering function or selective answering device.
- e. Incoming call priority function. The visual or audible signals shall indicate if a routine or emergency (and/or code) call has been placed and shall continue until the call is canceled. The emergency calls shall be capable of being canceled only at the originating station. Provide for the programming to two levels of priority, minimum, for incoming calls from each associated bedside station.
- f. Reminder function. Shall temporarily store a placed call and generate visual signals in the corridor dome light associated with the calling bedside station by activating the reminder function/circuitry. The visual signals shall terminate and the stored call is eliminated from memory when the call is canceled at the originating station.
- g. The ability to generate visual and audible signals to indicate incoming calls from associated stations which:
  - 1) Shall silence or attenuate the audible signals through muting/attenuation circuits while the control station is being used to answer or place a call. The audible signals for incoming calls not answered shall be automatically reenergized when the nurse control station is returned to the standby mode.
  - 2) The visual signals for incoming calls shall remain displayed at all times until each call is answered or canceled at the calling station.
  - 3) The visual and audible signals for routine and emergency calls shall be distinctly different. The audible signals shall be generated at the same rate as the corresponding visual signals for each emergency calls. Audible signals for routine calls shall be generated at the same rate as the visual signals, or by repeating an audible signal every five to ten seconds until the call is answered or canceled.
  - 4) The visual display to indicate the location of a placed call shall appear on the control station within two seconds, maximum, after initiation of a call.
- h. Touch pad, or equal, to permit the nurse to selectively place calls to and conduct two-way voice communication with, all system bedside, staff and duty stations and associated nurse stations. The touch pad shall also provide for the programming of priority status and any other function capable of being programmed from the nurse control station.
- i. The ability to monitor a bedside station. The wiring and/or equipment used shall assure that, when a station is being

monitored or called by the nurse control station, the call answered/monitor lamp station shall be lighted.

- j. The capability of paging a minimum of 10 bedside stations simultaneously.
  - k. The ability to receive calls from a minimum of 10 associated stations simultaneously.
  - l. The ability for answering placed calls by either:
    - 1) Picking up the handset or by activating an answer next call function, which will automatically permit the nurse to communicate with the station that is next in sequence of placed calls by priority and time of placement, or
    - 2) By being able to selectively answer any placed call displayed in the order of priority and time of placement.
  - m. Accommodate a minimum of 10 percent expansion of additional patient, emergency, staff and duty stations within each master nurse control station as installed without any additions to the central equipment.
  - n. Nurse control master stations that require AC power and/or have video type (or CRT) display units associated with them, shall be connected to the same Emergency Critical Care Distribution System AC power panel that supplies AC power to its associated central terminal cabinet. A UPS shall be provided at the nurse station location to supply battery back up power to the station and CRT equipment if they are not powered from the central terminal equipment battery backup system.
4. Product: Rauland 351200 Standard Console. Substitutions not permitted.

#### **2.4 DISTRIBUTION SYSTEM**

- A. Refer to Specification Sections 27 10 00, STRUCTURED CABLING and 27 12 00, COMMUNICATIONS CABLING EXPANSION for additional VHA wire and cable standards and installation requirements. Each wire and cable used in the System shall be specifically OEM certified by tags on each reel and recommended and approved for installation in the Facility. The Contractor shall provide the COR a 610 mm (2 foot) sample of each wire and/or cable actually employed in the System and each certification tag for approval before continuing with the installation as described herein.

#### **2.5 INSTALLATION KIT**

- A. The kit shall be provided that at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or wiring block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the COR all unused and partially opened installation kit boxes, coaxial cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls,

physical installation hardware. This is an acceptable alternate to the individual spare equipment requirement as long as the minimum spare items are provided in this count. The following are the minimum required installation sub-kits:

**B. System Grounding:**

1. The grounding kit shall include all cable and installation hardware required. All A/V nurse call equipment shall be connected to earth ground via internal building wiring, according to the NEC.
2. This includes, but is not limited to:
  - a. Control Cable Shields
  - b. Data Cable Shields
  - c. Conduits
  - d. Cable Duct
  - e. Cable Trays
  - f. Power Panels
  - g. Connector Panels

**C. Wire and Cable:** The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, wiring blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.

**D. Conduit, Cable Duct, and Cable Tray:** The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.

**E. Equipment Interface:** The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface Systems and sub-systems according to the OEM requirements and this document.

**F. Labels:** The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each sub-system according to the OEM requirements, record drawings, and this document.

**G. Documentation:** The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

**A. Product Delivery, Storage and Handling**

1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name, equipment model and serial identification numbers, and UL logo. The COR may

inventory the nurse call equipment at the time of delivery and reject items that do not conform to this requirement.

2. Storage and Handling: Store and protect equipment in a manner that will preclude damage as directed by the COR.

B. System Installation

1. Do not install nurse call and fire alarm systems in the same conduit, raceway or cable trays.
2. For VA Facilities, it is permissible to include non-powered RED and MATV cables with nurse call cables provided each signal is directly controlled by its system and each cable is 100% shielded and bundled as described herein.
3. The Contractor shall provide suitable filters, traps and pads for minimizing interference and for balancing the amplifiers and distribution system(s). Items used for balancing and minimizing interference shall be able to pass audio, data and control signals in the speeds and frequency bands selected, in the directions specified, with low loss, and high isolation and with minimum delay of the system poling or subcarrier frequency(s).
4. Back up power supplies (e.g., batteries, UPS) shall be installed in the central equipment cabinet or in a separate metal cabinet equipped with a hinged door and lock. If a separate cabinet is installed, it shall be provided adjacent to the central equipment cabinet. Where the backup power supply is already self-contained in a housing, the unit can be mounted adjacent to the respective equipment cabinet. In all cases, backup power supplies must be permanently mounted. Each UPS and/or backup power supply shall be provided with full electrical supervision as described herein.
5. All passive equipment shall be connected according to the OEM's specifications to insure correct termination, isolation, impedance match, and signal level balance at each speaker.
6. Install all equipment for each location specified herein and as identified on the drawings.
7. All trunk, distribution and interconnecting lines shall be terminated in a suitable manner to facilitate future expansion of the System by adding center terminal equipment only.
8. All vertical and horizontal lines shall be terminated so that subsequent expansion for additional audio channels shall require modifications of the System central terminal equipment only.
9. Terminating resistors shall be used to terminate all unused branches, outlets, unused equipment ports of the System and shall be devices designed for the purpose of terminating audio cables carrying audio signals in nurse call systems.

B. Conduit and Signal Ducts:

1. Conduit:
  - a. The Contractor shall employ the latest installation practices and materials. The minimum conduit size shall be 25 mm (1 inch) in diameter for primary signal distribution and 19 mm (3/4 inch) for

remote connections (i.e. dome lights, emergency station, TV control, RED control, etc.).

- b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow nurse call cables to be installed in partitioned cable tray with RED and MATV cables, shall be granted in writing by the COR if requested.) The mixing of nurse call and fire alarm cables and/or systems is not authorized and will not be approved. (See caution identified in paragraph 3-1b.3.e.). Conduit shall be provided in accordance with Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, at a minimum.
  - c. Conduit fill shall not exceed 40 percent.
  - d. Cable runs shall be splice free between conduit junction and interface boxes and equipment locations.
2. Signal Duct, Cable Duct, or Cable Tray:
- a. The Contractor shall use existing signal duct, cable duct and/or cable tray, when identified and approved by the COR.
  - b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 inch x 4 inch) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides, or barriers are required on all sharp corners, openings, anchors, bolts, or screw ends, junction, interface and connection points.
  - c. Approved cable tray shall be fully covered, mechanically and physically partitioned for multiple electronic circuit use, and UL certified and labeled for use with telecommunication circuits and/or systems. The COR shall approve width and height dimensions. Open, wire basket, or ladder type cable trays are not permitted.
  - d. Do not pull wire or cable through any box, fitting or enclosure where change of approved conduit, cable tray, signal, or cable duct alignment or direction occurs. Ensure the proper bend radius is maintained for each wire or cable as specified by its OEM.
  - e. Employ temporary guides, sheaves, rollers, and other necessary items to protect the wire or cable from excess tension or damaging bending during installation. Abrasion to wire or cable jackets is not acceptable and will not be allowed. Replace all cables whose jackets has been abraded the discovery of any abraded and/or damaged cables during the proof of performance test shall be grounds for declaring the entire system unacceptable and the termination of the proof of performance test. Completely cover edges of wire or cable passing through holes in chassis, cabinets or racks, enclosures, pull or junction boxes, conduit, etc., with plastic or nylon grommetting.
  - f. All cable junctions and taps shall be accessible. Do not install junction blocks, multi distribution connections or other distribution equipment (active or passive) items inside signal ducts. Use a 150 mm x 150 mm x 100 mm (6 inch x 6 inch x 4 inch) minimum covered junction box attached to the signal duct fixed side for distribution system passive equipment installation.



Ensure all equipment and connection assembly junctions are accessible.

C. Distribution System Signal Wires and Cables

1. Wires and cables shall be provided in the same manner and use like construction practices as Fire Protective and other Emergency Systems that are identified and outlined in NFPA 101, Life Safety Code, Chapters 7, 12, and/or 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions. The wires and cables shall be able to withstand adverse environmental conditions location without deterioration. Wires and cables shall enter each equipment enclosure, console, cabinet, or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
2. Routing and Interconnection:
  - a. Wires or cables routed between consoles, cabinets, racks, and other equipment shall be installed in an approved conduit, signal duct, cable duct, or cable tray that is secured to building structure.
  - b. Wires and cables shall be insulated to prevent contact with signal or current carrying conductors and be 100% shielded. Wires or cables used in assembling consoles, panels, equipment cabinets and racks shall be formed into harnesses that are bundled and tied. Harnessed wires or cables shall be combed straight, formed and dressed in either a vertical or horizontal relationship to equipment, controls, components or terminations.
  - c. Harnesses with intertwined members are not acceptable. Each wire or cable that breaks out from a harness for connection or termination shall have been tied off at that harness or bundle point, and provided with a neatly formed service loop.
  - d. Wires and cables shall be grouped according to service (i.e.: AC, grounds, signal, DC, control, etc.). DC, control and signal cables may be included with any group. Wires and cables shall be neatly formed and shall not change position in the group throughout the conduit run. Wires and cables in approved signal duct, conduit, cable ducts, or cable trays shall be neatly formed, bundled and tied off in 600 mm to 900 mm (24 to 36 inch) lengths and shall not change position in the group throughout the run. Concealed splices are not allowed.
  - e. Separate, organize, bundle, and route wires or cables to restrict channel crosstalk or feedback oscillation inside any enclosure. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC, and speaker wires or cables on the left; coaxial, control, microphone, and line level audio and data wires or cables, on the right. This installation shall be accomplished with ties and/or fasteners that will not damage or distort the wires or cables. Limit spacing between tied off points to a maximum of 150 mm (6 inches).
  - f. Distribution cables shall be installed and fastened without causing sharp bends or rubbing of the cables against sharp edges.

Cables shall be fastened with hardware that will not damage or distort them.

- g. Cables shall be labeled with permanent markers at the terminals of the electronic and passive equipment and at each junction point in the System. The lettering on the cables shall correspond with the lettering on the record diagrams.
  - h. Completely test all of the cables after installation and replace any defective cables.
  - i. Provide system input and output polarity as recommended by the OEM. Insure each color coded wire or cable is connected and terminated to maintain system polarity to be at least the same quality of professional audio systems. Reflect all color codes, wire and cable terminations on the System's record drawings as required herein.
- D. Outlet Boxes, Back Boxes, and Face Plates
- 1. Outlet Boxes: Signal, power, interface, connection, distribution, and junction boxes shall be provided as required by the system design, on-site inspection, and review of the contract drawings.
  - 2. Back Boxes: Back boxes shall be provided as directed by the OEM as required by the approved system design, on-site inspection, and review of the contract drawings.
  - 3. Face Plates (or Cover Plates): Face plates shall be of a standard type, stainless steel, anodized aluminum or UL approved cyclac plastic construction and provided by the Contractor for each identified system location. Connectors and jacks appearing on the face plate shall be clearly and permanently marked.
- E. Connectors: Circuits, transmission lines and signal extensions shall have continuity, correct connection, and polarity. Polarity shall be maintained between all points in the System.
- 1. Wires:
    - a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable and will not be approved.
    - b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Wiring blocks are approved for signal, not AC wires. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.
  - 2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system cable connectors include; but, are not limited to: Audio spade lug, wiring block, wirewrap, etc.
- F. AC Power: AC power wiring shall be run separately from signal cable.
- G. Grounding:

1. General: The Contractor shall ground all Contractor installed equipment to eliminate all shock hazard and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less:
    - a. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.
    - b. The use of conduit, signal duct, or cable trays as system or electrical ground is not acceptable and will not be permitted. These items may be used only for the dissipation of internally generated static charges [not to be confused with externally generated lightning] that may be applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.
  3. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.
  4. Equipment: Equipment shall be bonded to the cabinet ground bus with copper braid equivalent to at least #12 AWG. Self grounding equipment enclosures, racks or cabinets, that provides OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternates.
  5. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, face plates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.
- H. Equipment Assembly:
1. Cabinets:
    - a. Signal equipment, patch or bulkhead connector panels (i.e.: audio, data, control, etc.) shall be connected so that output for from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front, which will be called "input". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front, which will be called "output".
- I. Labeling: Abbreviations may be used as long as they are symbol(s) or acronyms designated for the System or equipment by accepted industry standards and each abbreviation is used on the appropriate system and sub-system "record" drawing.
1. Cable and Wires (Hereinafter referred to as "Cable"): The Contractor shall install labels on all cables at each side of all connections.

The labeling shall be permanent, with contrasting identification alpha or numeric, identifying each cable according to the System "as record" drawings. Labels shall be installed adjacent to each mechanical connector, pull box or break in the cable run.

2. Equipment: The Main Nurse Call Control Panel, amplifying, control, switching, and routing equipment inputs and outputs shall be permanently labeled with contrasting plastic laminate or bakelite material. System equipment shall be permanently labeled on the face of the unit corresponding to its source. Remote control equipment shall be labeled according to the unit or system being controlled. Equipment labels shall be permanently affixed to the equipment with metal screws, permanent mounting devices or cement.
3. AC Power: The AC Power Panel Directory shall identify which equipment console, cabinet or enclosure that it serves. Each equipment console, cabinet or enclosure shall be labeled to identify which AC power panel provides power to it. These labels shall be permanently affixed to the equipment with metal screws, permanent mounting devices or cement.
4. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct, and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum every 3 meters (10 feet) identifying it as the System. Also, each enclosure shall be labeled according to this standard.

### **3.2 PROOF OF PERFORMANCE TESTS**

#### **A. Intermediate Testing:**

1. After completion of the installation of a central control cabinet and equipment, nurse control master station, local and remote enunciation stations (code one [blue] systems only), the first ward (maximum of two wards), and prior to any further work, this portion of the System must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed, NFPA, Life Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
2. The inspection and test will be conducted by a factory-certified representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the COR, until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 80% point of the system construction phase, at the direction of the COR.

#### **B. Pretesting:**

1. Upon completing installation of the System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.

2. Pretesting Procedure:

- a. During the System pretest the Contractor shall verify (utilizing approved spectrum analyzer and test equipment) that the System is fully operational and meets all the System performance requirements of this standard.
  - b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
    - 1) Central Control Cabinets
    - 2) Nurse Control Stations
    - 3) Staff Stations
    - 4) Local and Remote Enunciation Panels (code one [blue] only)
    - 5) All Networked locations
    - 6) System interface locations (i.e. two way radio, PA, etc.)
    - 7) System trouble reporting
    - 8) System supervision
    - 9) UPS operation
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the COR.

C. Acceptance Test:

1. After the System has been pretested and the Contractor has submitted the pretest results and certification to the COR, then the Contractor shall schedule an acceptance test date and give the COR 30 days written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a Government Representative and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance. The test shall verify that the total System meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed System does comply with all requirements of this specification under operating conditions. The System shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the System that precludes completion of system testing, and which cannot be repaired in four (4) hours, shall be cause for terminating the acceptance test of the System. Repeated failures that result in a cumulative time of eight (8) hours to effect repairs, shall cause the entire System to be

declared unacceptable. Retesting of the entire System shall be rescheduled at the convenience of the Government.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

- a. The Government Representative will tour all major areas where the System is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
- b. The System diagrams, record drawings, equipment manuals, Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
- c. Failure of the System to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

- a. After the Physical and Mechanical Inspection, the central terminating and nurse call master control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this requirement.
- b. Following the central equipment test, a pillow speaker (or on board speaker) shall be connected to the central terminating and nurse call master control equipment's output tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
- c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last intersectional, room, and bed dome light in each leg to verify that the nurse call distribution system meets all system performance standards.
- f. Additionally, each installed emergency, staff, duty, panic station, intersectional, room, and bed dome light, power supply, code one, and remote annunciator panels shall be checked insuring they meet the requirements of this specification.
- g. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system. The typical functions are: nurse follower, three levels of emergency signaling (i.e. flashing red emergency, flashing white patient emergency, flashing white or combination lights for staff emergency, separate flashing code blue), minimum of ten minutes of UPS operation, memory saving, minimum of ten station audio paging, canceling emergency calls at each originating station only, and storage and prioritizing of calls.
- h. Individual Item Test: The Government Representative will select individual items of equipment for detailed proof of performance testing until 100% of the System has been tested and found to

meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

3. Test Conclusion:

- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the COR. Any retesting to comply with these specifications will be done at the Contractor's expense.
- b. If the System is declared unacceptable without conditions, all rescheduled testing expenses will be born by the Contractor.

**3.3 TRAINING**

- A. Furnish the services of a factory-trained engineer or technician for four eight-hour periods to instruct the Facility's maintenance personnel. Instruction shall include corrective and preventive maintenance of the nurse call equipment. Training shall be accomplished before the VA can accept the System. Additionally, training will be scheduled at the convenience of the Facility's, Chief Engineering Service.
- B. Furnish the services of a representative of the nurse call and code one OEM, familiar with the functions and operation of the equipment, for two eight-hour periods to train nursing personnel. Instructions shall be provided for staff personnel in each ward where new nurse call and code one (blue) equipment is provided under this contract. When multiple wards are involved, classes will be grouped. Periods of training shall be coordinated with the Chief of Nursing Service for the Facility to ensure all nursing shifts receive the required training. Each session shall include instructions utilizing a factory prepared and COR approved vertical - horizontal system (VHS) format video tape presentation and "hands-on" operation of the nurse call and code one (blue) equipment on a hospital ward. The tape presentation shall be sufficient in detail to stand-alone as a training aid for initial utilization and familiarization of the System. Additionally, the Contractor shall provide two (2) copies of the video presentation to the Chief of Nursing Service.

**3.4 GUARANTEE PERIOD OF SERVICE**

- A. Contractor's Responsibility:
  1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the System by the VA. The Contractor shall provide OEM's equipment warranty documents, to the COR, certifying each item of equipment installed conforms to OEM published specifications.
  2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.

3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the one year guaranty period.

B. Response Time During the One Year Guaranty Period:

1. The COR or Facility Contracting Officer is the Contractor's reporting and contact official for nurse call system trouble calls, during the guaranty period.
2. A standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal Holidays.
3. The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
  - a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes a pillow speaker or cordset, master nurse control station, patient station, emergency station, or dome light to be inoperable.
  - b. An emergency trouble call within four hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or code one system to be inoperable at anytime.
4. If a nurse call and/or code one (blue) component failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate nurse call equipment. The alternate equipment/system shall be operational within a maximum of four hours after the four hour trouble shooting time and restore the effected location operation to meet the System performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the System or sub-system to full operational capability, as described herein, until repairs are complete.

C. Required On-Site Visits During the One Year Guaranty Period

1. The Contractor shall visit, on-site, for a minimum of eight hours, once every 12 weeks, during the guaranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this document.
2. The Contractor shall arrange all Facility visits with the COR or Facility Contracting Officer prior to performing the required maintenance visits.
3. Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the COR or Facility Contracting Officer and Contractor.
4. The preventive maintenance schedule, functions and reports shall be provided to and approved by the COR or Facility Contracting Officer.



5. The Contractor shall provide the COR or Facility Contracting Officer a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the COR with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
  - a. The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to COR or Facility Contracting Officer by the fifth working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
  - b. The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.
6. The COR or Facility Contracting Officer shall convey to the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
  - a. The COR or Facility Contracting Officer shall ensure a copy of these reports is entered into the System's official acquisition documents.
  - b. The Facility Chief Engineer shall ensure a copy of these reports is entered into the System's official technical record documents.
- D. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the COR or Facility Contracting Officer in writing upon the discovery of these incidents. The COR or Facility Contracting Officer will investigate all reported incidents and render findings concerning any Contractor's responsibility.

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**SECTION 28 05 11**  
**REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section, Requirements for Electronic Safety and Security Installations, applies to all sections of Division 28.
- B. Furnish and install electronic safety and security cabling, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of, cable and other items and arrangements for the specified items are shown on drawings.

**1.2 MINIMUM REQUIREMENTS**

- A. References to industry and trade association standards and codes are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

**1.3 QUALIFICATIONS (PRODUCTS AND SERVICES)**

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- B. Product Qualification:
  - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
  - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

**1.4 MANUFACTURED PRODUCTS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the COR a minimum of 15 working days prior to the manufacturers making the factory tests.
  - 2. Four copies of certified test reports containing all test data shall be furnished to the COR prior to final inspection and not more than 90 days after completion of the tests.
  - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

#### **1.5 EQUIPMENT REQUIREMENTS**

- A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

#### **1.6 EQUIPMENT PROTECTION**

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
  - 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.

2. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

#### **1.7 WORK PERFORMANCE**

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

#### **1.8 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Inaccessible Equipment:
  1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
  2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

#### **1.9 EQUIPMENT IDENTIFICATION**

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as

a standard catalog item, or where other method of identification is herein specified, are exceptions.

**1.10 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
  - 1. Mark the submittals, "SUBMITTED UNDER SECTION\_\_\_\_\_".
  - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  - 3. Submit each section separately.
- E. The submittals shall include the following:
  - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
  - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
  - 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  - 1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of

- systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
  3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
  4. The manuals shall include:
    - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
    - b. A control sequence describing start-up, operation, and shutdown.
    - c. Description of the function of each principal item of equipment.
    - d. Installation and maintenance instructions.
    - e. Safety precautions.
    - f. Diagrams and illustrations.
    - g. Testing methods.
    - h. Performance data.
    - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
    - j. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- G. Approvals will be based on complete submission of manuals together with shop drawings.
- H. After approval and prior to installation, furnish the COR with one sample of each of the following:
1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
  2. Each type of conduit and pathway coupling, bushing and termination fitting.
  3. Conduit hangers, clamps and supports.
  4. Duct sealing compound.

- I. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

**1.11 SINGULAR NUMBER**

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

**1.12 TRAINING**

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the COR at least 30 days prior to the planned training.

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**SECTION 28 05 13**  
**CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of the conductors and cables for electronic safety and security.

**1.2 RELATED WORK**

- A. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. General electrical requirements that are common to more than one section in Division 28: Section 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.
- C. Conduits for cables and wiring: Section 28 05 33, RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

**1.3 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Manufacturer's Literature and Data: Showing each cable type and rating.
  2. Certificates: Two weeks prior to final inspection, deliver to the // COR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

**1.4 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):  
D2301-04.....Standard Specification for Vinyl Chloride  
Plastic Pressure Sensitive Electrical Insulating  
Tape
- C. Federal Specifications (Fed. Spec.):  
A-A-59544-00.....Cable and Wire, Electrical (Power, Fixed  
Installation)
- D. National Fire Protection Association (NFPA):



- 70-14.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
- 44-02.....Thermoset-Insulated Wires and Cables
- 83-03.....Thermoplastic-Insulated Wires and Cables
- 467-01.....Electrical Grounding and Bonding Equipment
- 486A-01.....Wire Connectors and Soldering Lugs for Use with  
Copper Conductors
- 486C-02.....Splicing Wire Connectors
- 486D-02.....Insulated Wire Connector Systems for Underground  
Use or in Damp or Wet Locations
- 486E-00.....Equipment Wiring Terminals for Use with Aluminum  
and/or Copper Conductors
- 493-01.....Thermoplastic-Insulated Underground Feeder and  
Branch Circuit Cable
- 514B-02.....Fittings for Cable and Conduit
- 1479-03.....Fire Tests of Through-Penetration Fire Stops

## **PART 2 - PRODUCTS**

### **2.1 CONTROL WIRING**

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

### **2.2 COMMUNICATION AND SIGNAL WIRING**

- A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.
- C. Multi-conductor cables shall have the conductors color coded.

### **2.3 WIRE LUBRICATING COMPOUND**

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

### **2.4 FIREPROOFING TAPE**

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Splice cables and wires only in outlet boxes, junction boxes, or pull boxes.
- B. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- C. Wire Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
  - 2. Use ropes made of nonmetallic material for pulling feeders.
  - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COR.
  - 4. Pull in multiple cables together in a single conduit.

#### **3.2 INSTALLATION IN MANHOLES (NOT USED)**

#### **3.3 SPLICE INSTALLATION**

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

#### **3.4 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

- D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

**3.5 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION**

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

**3.5 EXISITNG WIRING**

- A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

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**SECTION 28 13 00**  
**PHYSICAL ACCESS CONTROL SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification of a complete and fully operating Physical Access Control System, hereinafter referred to as the PACS.
- B. This Section includes a Physical Access Control System consisting of field-installed Controllers connected by a high-speed electronic data transmission network.
- C. PACS shall provide secure and reliable identification of Federal employees and contractors by utilizing credential authentication per FIPS-201.
- D. Physical Access Control System (PACS) Description:
  - 1. The PACS shall connect to existing Head-End equipment server in building 70 Biomed Server Room BG-111.
  - 2. The PACS outlined in this section and detailed in Part 2 of this document is the key central component for managing physical security and the bridge between physical and logical security for this project. The system shall provide a variety of integral functions including the ability to regulate; provide identification credentials; monitor, track and interface alarms.
  - 3. The PACS shall be able to seamlessly interface with and monitor intelligent system controllers, reader interface modules, I/O panels, burglar alarm panels, burglar alarm panel receivers, biometric devices, personal protection devices, intercom systems, fire alarm panels (secondary monitoring only), building management systems and digital video recorders approved for use by the PACS manufacturer.
  - 4. The PACS shall be able to communicate with intelligent system controllers via RS-485, RS-232, TCP-IP/Ethernet and Dial-up via Modem.
- E. Information system supporting PACS, Head-End equipment server, workstations, network switches, routers and controllers shall comply with FIPS 200 requirements (Minimum Security Requirements for Federal

Information and Information Systems) and NIST Special Publication 800-53  
(Recommended Security Controls for Federal Information Systems).

- F. System Software: Extension of existing Lenel Systems International  
OnGuard 2010 central-station, workstation operating system, server  
operating system, and application software.

## **1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping  
application and use.
- C. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- D. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- E. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.  
Requirements for connection of high voltage.
- F. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES  
(600 VOLTS AND BELOW). Requirements for power cables.
- G. Section 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.  
Requirements for infrastructure.
- I. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND  
SECURITY. For general requirements that are common to more than one  
section in Division 28.
- J. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND  
SECURITY. Requirements for conductors and cables.
- K. Section 28 31 00 - FIRE DETECTION AND ALARM. Requirements for  
integration with fire detection and alarm system.

## **1.3 QUALITY ASSURANCE**

- A. Refer to 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND  
SECURITY, Part 1
- B. The security system will be installed and tested to ensure all  
components are fully compatible as a system and can be integrated with  
all associated security subsystems, whether the security system is  
stand-alone or a part of a complete Information Technology (IT)  
computer network.
- C. Manufacturers Qualifications: The manufacturer shall regularly and  
presently produce, as one of the manufacturer's principal products, the

equipment and material specified for this project, and shall have manufactured the item for at least three years.

D. Product Qualifications:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

E. Contractor Qualifications:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
  - a. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
  - b. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide

consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- G. Installation shall comply with NFPA 70, "National Electrical Code."

#### **1.4 SUBMITTALS**

- A. Shop Drawings: Provide complete shop drawings which include the following:
  - 1. Include full schematic wiring information on these drawings for all devices. Wiring information shall include cable type, conductor routings, quantities, and connection details at device
  - 2. Include a complete PACS one-line, block diagram.
  - 3. Include a statement of the system sequence of operation.
- B. Product Data: Provide complete product data that includes the following:
  - 1. Manufacturer's technical data for all material and equipment at the system and sub system level to be provided as part of the PACS.
  - 2. A system description including analysis and calculations used in sizing equipment required by the PACS. The description shall show how the equipment will operate as a system to meet the performance requirements of the PACS. The following information shall be supplied as a minimum:
    - a. Server(s) processor(s), disk space and memory size
    - b. Description of site equipment and its configuration
    - c. Network bandwidth, latency and reliability requirements
    - d. Backup/archive system size and configuration
    - e. Startup operations
    - f. System expansion capability and method of implementation
    - g. System power requirements and UPS sizing
    - h. Device / component environmental requirements (cooling and or heating parameters)

- i. A description of the operating system and application software.
- C. Contract Close-Out Submittals: Provide the number of sets of hard copy manuals and the number of sets of electronic format manuals including operating instructions, maintenance recommendations and parts list including wiring and connection diagrams modified to reflect as-built conditions as indicated in Division 1.
- 1. Manuals: Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of the contractor responsible for the installation and maintenance of the system and the factory representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation test shall include all modifications made during installation, checkout, and acceptance testing. The manuals shall consist of the following:
    - a. Functional Design Manual: The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included.
    - b. Hardware Manual: The manual shall describe all equipment furnished including:
      - 1) General description and specifications
      - 2) Installation and check out procedures
      - 3) Equipment layout and electrical schematics to the component level
      - 4) System layout drawings and schematics
      - 5) Alignment and calibration procedures
      - 6) Manufacturers repair parts list indicating sources of supply
    - c. Software Manual: The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
      - 1) Definition of terms and functions



- 2) System use and application software
- 3) Initialization, start up, and shut down
- 4) Reports generation
- 5) Details on forms customization and field parameters
- d. Operators Manual: The operators manual shall fully explain all procedures and instructions for the operation of the system including:
  - 1) Computers and peripherals
  - 2) System start up and shut down procedures
  - 3) Use of system, command, and applications software
  - 4) Recovery and restart procedures
  - 5) Graphic alarm presentation
  - 6) Use of report generator and generation of reports
  - 7) Data entry
  - 8) Operator commands
  - 9) Alarm messages and reprinting formats
  - 10) System permissions functions and requirements
- e. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
- f. As-Built Drawings: During system installation, the Contractor shall maintain a separate hard copy set of drawings, elementary diagrams, and wiring diagrams of the PACS to be used for record drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the PACS. Copies of the final as-built drawings shall be provided to the end user in DXF format.

D. FIPS 201 Compliance Certificates

- 1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
  - a. Card Readers
  - b. PIV Middleware
  - c. Template Matcher
  - d. Certificate Management
    - 1) CAK Authentication System

- 2) PIV Authentication System
- 3) Certificate Validator
- 4) Cryptographic Module

P. Approvals will be based on complete submission of manuals together with shop drawings.

#### 1.5 APPLICABLE PUBLICATIONS

- A. Refer to 25 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY
- B. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
  - AC-03.....Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards
  - TVAC-01.....CCTV to Access Control Standard - Message Set for System Integration
- C. American National Standards Institute (ANSI)/ International Code Council (ICC):
  - A117.1.....Standard on Accessible and Usable Buildings and Facilities
- D. Department of Justice American Disability Act (ADA)
  - 28 CFR Part 36.....ADA Standards for Accessible Design 2010
- E. Department of Veterans Affairs (VA):
  - PACS-R: Physical Access Control System (PACS) Requirements
  - VA Handbook 0730 Security and Law Enforcement
- F. Government Accountability Office (GAO):
  - GAO-03-8-02 Security Responsibilities for Federally Owned and Leased Facilities
- G. National Electrical Contractors Association
  - 303-2005.....Installing Closed Circuit Television (CCTV) Systems
- H. National Electrical Manufacturers Association (NEMA):
  - 250-08.....Enclosures for Electrical Equipment (1000 Volts Maximum)
- I. National Fire Protection Association (NFPA):
  - 70-11..... National Electrical Code
- J. Underwriters Laboratories, Inc. (UL):

- 294-99.....The Standard of Safety for Access Control  
System Units
- 305-08.....Standard for Panic Hardware
- 639-97.....Standard for Intrusion-Detection Units
- 752-05.....Standard for Bullet-Resisting Equipment
- 827-08.....Central Station Alarm Services
- 1076-95.....Standards for Proprietary Burglar Alarm Units  
and Systems
- 1981-03.....Central Station Automation System
- 2058-05.....High Security Electronic Locks
- K. Homeland Security Presidential Directive (HSPD):
- HSPD-12.....Policy for a Common Identification Standard for  
Federal Employees and Contractors
- L. Federal Communications Commission (FCC):
- (47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems
- M. Federal Information Processing Standards (FIPS):
- FIPS-201-1.....Personal Identity Verification (PIV) of Federal  
Employees and Contractors
- N. National Institute of Standards and Technology (NIST):
- IR 6887 V2.1.....Government Smart Card Interoperability  
Specification (GSC-IS)
- Special Pub 800-63.....Electronic Authentication Guideline
- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-73-3....Interfaces for Personal Identity Verification  
(4 Parts)
- .....Pt. 1- End Point PIV Card Application  
Namespace, Data Model & Representation
- .....Pt. 2- PIV Card Application Card Command  
Interface
- .....Pt. 3- PIV Client Application Programming  
Interface
- .....Pt. 4- The PIV Transitional Interfaces & Data  
Model Specification
- Special Pub 800-76-1....Biometric Data Specification for Personal  
Identity Verification
- Special Pub 800-78-2....Cryptographic Algorithms and Key Sizes for  
Personal Identity Verification

- Special Pub 800-79-1....Guidelines for the Accreditation of Personal  
Identity Verification Card Issuers
- Special Pub 800-85B-1...DRAFTPIV Data Model Test Guidelines
- Special Pub 800-85A-2...PIV Card Application and Middleware Interface  
Test Guidelines (SP 800-73-3 compliance)
- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-37.....Guide for Applying the Risk Management  
Framework to Federal Information Systems
- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-104A....Scheme for PIV Visual Card Topography
- Special Pub 800-116.....Recommendation for the Use of PIV Credentials  
in Physical Access Control Systems (PACS)
- O. Institute of Electrical and Electronics Engineers (IEEE):
- C62.41.....IEEE Recommended Practice on Surge Voltages in  
Low-Voltage AC Power Circuits
- P. International Organization for Standardization (ISO):
- 7810.....Identification cards - Physical characteristics
- 7811.....Physical Characteristics for Magnetic Stripe  
Cards
- 7816-1.....Identification cards - Integrated circuit(s)  
cards with contacts - Part 1: Physical  
characteristics
- 7816-2.....Identification cards - Integrated circuit cards  
- Part 2: Cards with contacts -Dimensions and  
location of the contacts
- 7816-3.....Identification cards - Integrated circuit cards  
- Part 3: Cards with contacts - Electrical  
interface and transmission protocols
- 7816-4.....Identification cards - Integrated circuit cards  
- Part 11: Personal verification through  
biometric methods
- 7816-10.....Identification cards - Integrated circuit cards  
- Part 4: Organization, security and commands  
for interchange
- 14443.....Identification cards - Contactless integrated  
circuit cards; Contactless Proximity Cards

Operating at 13.56 MHz in up to 5 inches  
distance  
15693.....Identification cards -- Contactless integrated  
circuit cards - Vicinity cards; Contactless  
Vicinity Cards Operating at 13.56 MHz in up to  
50 inches distance  
19794.....Information technology - Biometric data  
interchange formats

Q. Uniform Federal Accessibility Standards (UFAS) 1984

R. ADA Standards for Accessible Design 2010

S. Section 508 of the Rehabilitation Act of 1973

#### **1.6 COORDINATION**

- A. Refer to 25 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY
- B. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

#### **1.8 MAINTENANCE & SERVICE**

- A. General Requirements
  - 1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing

scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items: computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, and signal transmission equipment.

C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The CO shall be advised in writing of the name of the designated service representative, and of any change in personnel. The CO shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays. These inspections shall include:
  - a) The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
    - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
    - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices,

monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

E. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
  - a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
  - b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

F. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

G. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

H. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying

the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

I. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

**1.09 GENERAL REQUIREMENTS**

- A. For general requirements that are common to more than one section in Division 28 refer to Section 28 05 00, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.
- B. General requirements applicable to this section include:
  1. Delivery, Handling and Storage
  2. Project Conditions
  3. Electrical Power
  4. Lightning, Power Surge Suppression, and Grounding
  5. Electronic Components
  6. Substitute Materials and Equipment

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide the following Security Management System products:
  1. Physical Access Control and Duress System
    - a. Lenel Systems International OnGuard 2010 Total Security Knowledge Management System.
    - b. HID, INC. Card Readers and Credential cards
    - c. United Security Panic, HUB-2B Latching



## **2.2 INPUT CONTROL MODULE (ICM)**

- A. The Input Control Module shall provide 16 UL 1076 Grade B, A or AA alarm input zones and monitor / report line fault conditions, alarm conditions, power faults and tampers. Status LEDs shall provide information about the sixteen alarm zone inputs, cabinet tamper, and power fault.
- B. In addition, the ICM shall incorporate the following features:
  - 1. UL 294, ULC, and CE Certified and Mercury Security Corp. compatible.
  - 2. Alarm contact status scanning at up to 180 times per second for each zone
  - 3. Eight configuration DIP switches to assign unit addresses and communications speed
  - 4. Variable resistor values for line supervision
  - 5. A low power CMOS microprocessor
  - 6. Filtered data for noise rejection to prevent false alarms
  - 7. Up to 16 Grade B, A, or AA Supervised Inputs in any Combination
  - 8. 12 or 24 VDC Input Power
  - 9. 2 Form C 5A, 30 VDC Contacts for load switching
  - 10. 2 dedicated inputs for tamper and power status
  - 11. RoHS Compliance
  - 12. Support for RS-485 over CAT 5, 6e cable

## **2.3 CARD READER (NOT USED)**

## **2.4 DOOR HARDWARE INTERFACE (NOT USED)**

## **2.5 DURESS SYSTEM**

- A. PACS shall include a duress system that includes hidden duress buttons at locations as indicated on drawings and security system integration to annunciate a duress alarm to the Security monitoring workstations.
- B. Duress buttons shall be constructed with an ABS plastic housing and include (2) Form C dry contacts. Voltage: 30V. Button shall be United Security Panic, HUB-2B latching.

- C. Wiring: 22AWG, 8 cord strand.
- D. Plate: Hubbell part# IFP110W, ivory in color, 1 gang, 1 port,
- E. Backplate: B-Line part#BB10
- F. Plug/Outlet: Telephone plug
  - 1. Ideal #RJ-116P6C, 6 position with two wires terminated on two middle positions or Plus, modular RJ-45, 8 position, stranded flat #4JY50 or solid round #4JY50 (2-wires landed on two center positions). No resistors.
- G. Installation Location: When installing on modular or desk furniture, install on left hand side, on side of drawer, with mounting screws in gap between drawer and side of desk, as close to the top of desk as possible. 1/8" drill.

## **2.6 CABLES**

- A. In this Article, coordinate the guidelines in the editor's notes for cable application with security system manufacturer's written recommendations.
- B. Interconnecting cabling required for connection to door hardware or other required security equipment shall be provided by the Security contractor. Provide hardware cabling as required by the manufacturer.

## **2.7 TRANSFORMERS**

- A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

# **PART 3 - EXECUTION**

## **3.1 GENERAL**

- A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation,

workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

- B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

### **3.2 CURRENT SITE CONDITIONS**

- A. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.

### **3.3 EXAMINATION**

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.4 PREPARATION**

- A. Comply with recommendations in SIA CP-01.
- B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."

### **3.5 CABLING**

- A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."
- B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."

- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- D. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.
- E. Install cables without damaging conductors, shield, or jacket.
- F. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- G. Install end-of-line resistors at the field device location and not at the Controller or panel location.

### **3.6 CABLE APPLICATION**

- A. Comply with EIA/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
- C. RS-232 Cabling: Install at a maximum distance of 50 feet (15 m).
- D. RS-485 Cabling: Install at a maximum distance of 4000 feet (1220 m).

### **3.7 GROUNDING**

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Signal Ground:
  - 1. Terminal: Locate in each equipment room; isolate from power system and equipment grounding.

2. Bus: Mount on wall of main equipment room with standoff insulators.
3. Backbone Cable: Extend from signal ground bus to signal ground terminal in equipment room.

### **3.8 INSTALLATION**

- A. System installation shall be in accordance with UL 294, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including any Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a operable system.
- D. The PACS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a network.
- E. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.
- F. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.
- G. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system. The Contractor shall not take any corrective action without written permission from the Government.
- H. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures shall comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by

the cable manufacturer and in such a manner that the cable is not damaged.

- I. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- J. Control Panels:
  - 1. Connect power and signal lines to the controller.
  - 2. Program the panel as outlined by the design and per the manufacturer's programming guidelines.
- K. PACS:
  - 1. Program and set-up the PACS to ensure it is fully operational.
- L. System Start-Up:
  - 1. The Contractor shall not apply power to the PACS until the following items have been completed:
    - a. PACS equipment items and have been set up in accordance with manufacturer's instructions.
    - b. A visual inspection of the PACS has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
    - c. System wiring has been tested and verified as correctly connected as indicated.
    - d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
    - e. Power supplies to be connected to the PACS have been verified as the correct voltage, phasing, and frequency as indicated.
  - 2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.
- M. Supplemental Contractor Quality Control:
  - 1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed PACS; and are approved by the Contracting Officer.

2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

### **3.9 SYSTEM SOFTWARE**

- A. Install, configure, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner and synchronize software and databases with existing VA Hospital Enterprise software.

### **3.10 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect[, test, and adjust] field-assembled components and equipment installation, including connections[, and to assist in field testing]. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.
  2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent

of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.

3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

### **3.11 PROTECTION**

- A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured. Coordinate access with the COR.

### **3.12 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Develop separate training modules for the following:
  1. Security personnel.
  2. Hardware maintenance personnel.
  3. Corporate management.
- D. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

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PROJECT NO. 618-CSI-100  
Renovate to Create Hybrid OR, Phase 2  
100% CD Issue  
03-30-2015

28 31 00  
**FIRE DETECTION AND ALARM**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified.
- B. Fire alarm systems shall comply with requirements of the NFPA 72 and the Department of Veterans Affairs Fire Protection Design Manual (4th Edition) unless variations are specifically identified within these contract documents by the following notation: [VARIATION]. The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the Contracting Officer or his authorized representative. Installers shall have a minimum of two years experience installing fire alarm systems.
- C. Fire Alarm Systems shall be noncoded addressable systems, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.
- D. The existing building fire alarm system is a Gamewell/FCI product that has an automatic digitized voice fire alarm signal with emergency manual voice override to notify occupants to evacuate. The digitized voice message shall identify the area of the building (smoke zone) from which the alarm was initiated.
- E. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit (located on plan drawings for each building).
- F. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

## 1.2 DEFINITIONS

- A. COR: Contracting Officer's Representative
- B. VA FPDM: Department of Veterans Affairs Fire Protection Design Manual
- C. LED: Light-emitting diode.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PIV: Post Indicator Valve
- F. VCS: Voice Communications Systems

## 1.3 SCOPE

- A. The existing fire alarm devices, wiring, and conduits to be reused and/or modified for the new layout of the area. Any additional devices needed for this project shall be provided as part of this contract.
- B. All programming of the main fire alarm panel shall be provided by a certified Gamewell, FCI contractor.
- C. A modified fire alarm system shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72, VA FPDM, and this specification.
- D. Basic Performance:
  - 1. Alarm and trouble signals from the building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
  - 2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed five (5) seconds.
  - 3. The signaling line circuits (SLC) between building fire alarm control units shall be wired Style 7 in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.
  - 4. Initiating device circuits (IDC) shall be wired Style C in accordance with NFPA 72.
  - 5. Signaling line circuits (SLC) within buildings shall be wired Style 4 in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet of floor space or 3 floors whichever is less.
  - 6. Notification appliance circuits (NAC) shall be wired Style Y in accordance with NFPA 72.

#### 1.4 DEFEND IN PLACE SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  - 1. Smoke detectors.
- B. Fire-alarm signal shall initiate the following actions:
  - 1. Activate voice/alarm communication system.
  - 2. Identify alarm at fire-alarm control unit and remote annunciators.
  - 3. Transmit an alarm signal to the remote alarm receiving station.
  - 4. Unlock electric door locks in designated egress paths.
  - 5. Release fire and smoke doors held open by magnetic door holders.
  - 6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
  - 7. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
  - 8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
  - 9. Recall elevators to primary or alternate recall floors.
  - 10. Activate emergency lighting control.
  - 11. Activate emergency shutoffs for gas and fuel supplies.
  - 12. Record events in the system memory.
  - 13. Record events by the system printer.
- C. System trouble signal initiation shall be by one or more of the following devices and actions:
  - 1. Open circuits, shorts, and grounds in designated circuits.
  - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
- D. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

#### 1.5 RELATED DOCUMENTS AND WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:

1. Section 01 00 00 - General Requirements: Restoration of existing surfaces
2. Section 01 33 23 - Submittals: Procedures for submittals
3. Section 07 84 00 - Fire Stopping: Fire proofing wall penetrations
4. Section 09 91 00 - Painting: Painting for equipment and existing surfaces
5. Section 26 05 11 - Requirements for Electrical Installations: General electrical requirements for items which are common to other Division 16 sections
6. Section 26 05 33 - Raceways and Boxes for Electrical Systems: Conduits and boxes for cables/wiring
7. Section 26 05 21 - Low Voltage Electrical Power Conductors and Cables (600V and Below): Cables/wiring

C. Applicable Publications

1. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only.
2. National Fire Protection Association (NFPA):
  - a. 70-2014 National Electrical Code (NEC).
  - b. 72-2002 National Fire Alarm Code.
  - c. 90A-2002 Installation of Air Conditioning and Ventilating Systems.
  - d. 101-2003 Life Safety Code
3. Department of Veterans Affairs Fire Protection Design Manual (4th Edition).
4. Underwriters Laboratories, Inc. (UL):
  - a. 2000-2000 Fire Protection Equipment Directory
5. Factory Mutual Research Corp (FM): Approval Guide, 2005 Edition
6. American National Standards Institute (ANSI):
  - a. S3.41-1996 Audible Emergency Evacuation Signal
7. International Code Council, International Building Code (IBC) 2003 Edition

1.6 SUBMITTALS

A. General Submittal Requirements:

1. Submit 4 copies and 1 reproducible in accordance with Section 01 3323 Submittals and Section 26 0511 Requirements for Electrical Installations.
2. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Engineer.

3. Shop Drawings shall be prepared by persons with the following qualifications:
  - a. NICET-certified fire-alarm technician, Level III minimum.

B. Product Data: For each type of product indicated.

C. Shop Drawings:

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.
3. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

D. Certifications:

1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
2. Together with the shop drawing submittal, submit a certification from the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Existing fire alarm system is Gamewell/FCI
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

#### 1.8 GUARANTY PERIOD SERVICES

- A. Complete inspection, testing, maintenance and repair service for the fire alarm system shall be provided by a factory trained authorized representative of the manufacturer of the major equipment for a period of five years from the date of acceptance of the entire installation by the Contracting Officer.
- B. Contractor shall provide all necessary test equipment, parts and labor to perform required inspection, testing, maintenance and repair.
- C. All inspection, testing, maintenance and permanent records required by NFPA 72, and recommended by the equipment manufacturer shall be provided by the contractor. Work shall include operation of sprinkler system alarm and supervisory devices as well as all reused existing equipment connected to the fire alarm system. It shall include all interfaced equipment including but not limited to elevators, HVAC shutdown, and extinguishing systems.
- D. Maintenance and testing shall be performed in accordance with NFPA 72. A computerized preventive maintenance schedule shall be provided and shall describe the protocol for preventive maintenance of equipment. The schedule shall include a systematic examination, adjustment and cleaning of all equipment.
- E. Non-included Work: Repair service shall not include the performance of any work due to improper use, accidents, or negligence for which the contractor is not responsible.
- F. Service and emergency personnel shall report to the Engineering Office or their authorized representative upon arrival at the hospital and again upon the completion of the required work. A copy of the work ticket containing a complete description of the work performed and parts replaced shall be provided to the VA Contracting Officer or his authorized representative.
- G. Emergency Service:
  - 1. Warranty Period Service: Service other than the preventative maintenance, inspection, and testing required by NFPA 72 shall be considered emergency call-back service and covered under the warranty of the installation during the first year of the warranty period, unless the required

service is a result of abuse or misuse by the Government. Written notification shall not be required for emergency warranty period service and the contractor shall respond as outlined in the following sections on Normal and Overtime Emergency Call-Back Service. Warranty period service can be required during normal or overtime emergency call-back service time periods at the discretion of the Contracting Officer or his authorized representative.

2. Normal and overtime emergency call-back service shall consist of an on-site response within two hours of notification of a system trouble.
3. Normal emergency call-back service times are between the hours of 7:30 a.m. and 4:00 p.m., Monday through Friday, exclusive of federal holidays. Service performed during all other times shall be considered to be overtime emergency call-back service. The cost of all normal emergency call-back service for years 2 through 5 shall be included in the cost of this contract.
4. Overtime emergency call-back service shall be provided for the system when requested by the Government. The cost of the first 40 man-hours per year of overtime call-back service during years 2 through 5 of this contract shall be provided under this contract. Payment for overtime emergency call-back service in excess of the 40 man hours per year requirement will be handled through separate purchase orders. The method of calculating overtime emergency call-back hours are based on actual time spent on site and does not include travel time.

H. The contractor shall maintain a log at each fire alarm control unit. The log shall list the date and time of all examinations and trouble calls, condition of the system, and name of the technician. Each trouble call shall be fully described, including the nature of the trouble, necessary correction performed, and parts replaced.

I. In the event that VA modifies the fire alarm system post-Acceptance but during the five year Guaranty Period Service period, Contractor shall be required to verify that the system, as newly modified or added, is consistent with the manufacturer's requirements; any verification performed will be equitably adjusted under the Changes clause. The post-Acceptance modification or addition to the fire alarm system shall not void the continuing requirements under this contract set forth in the Guarantee Period Service provision for the fire alarm system as modified or added. The contract will be equitably adjusted under the Changes clause for such additional performance.

#### 1.9 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging



to provide temporary guard service according to requirements indicated:

1. Notify Owner/Owner's Representative no fewer than 5 working days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Owner/Owner's Representative written permission.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Gamewell/FCI (No Substitutions)

### 2.2 EQUIPMENT AND MATERIALS, GENERAL

- A. All added equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturer's requirements and that satisfactory total system operation has been achieved

### 2.3 CONDUIT, BOXES, AND WIRE

- A. Conduit shall be in accordance with Section 16111, CONDUIT SYSTEMS and as follows:
1. All new conduits shall be installed in accordance with NFPA 70.
  2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
  3. All new conduits shall be ¾-inch minimum.
- B. Wire:
1. All existing wiring that is not reused shall be removed after new wiring installed in conduit or raceway and the new system is fully functional.
  2. Wiring shall be in accordance with NEC article 760, Section 26 0521 and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for

initiating device circuits and 14 AWG for notification device circuits.

3. Addressable circuits and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically exempted by the fire alarm equipment manufacturer in writing.

C. Terminal Boxes, Junction Boxes, and Cabinets:

1. Shall be galvanized steel in accordance with UL requirements.
2. All new boxes shall be sized and installed in accordance with NFPA 70.
3. New and existing covers shall be repainted red in accordance with Section 09 9100 Painting and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4-inch high.
4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COR.

2.4 FIRE ALARM CONTROL UNIT (EXISTING)

2.5 STANDBY POWER SUPPLY (EXISTING)

2.6 ALARM NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

2. Utilize existing local circuit with spare capacity.

- B. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens and visible from all viewing directions.

Flash rate shall be 1 Hz, with synchronization where required by NFPA 72.

1. Rated Light Output:
  - a. 15/30/75/110 cd, selectable in the field.
2. Mounting: Ceiling mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, white.

C. VCS Speakers:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. Nominal Dimension: 8-inch diameter cone-type
3. Operate on either 25VRMS or 70.7 VRMS
4. Output taps: 0.5W to 2.0W
5. Speakers shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
6. Frequency Response: 400 Hz to 4000 Hz
7. Mounting: Flush, unless noted otherwise.
8. Matching Transformers: Tap range matched to acoustical environment of speaker location.
9. Color: White

D. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: Flush, unless noted otherwise.
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

## 2.7 ALARM INITIATING DEVICES

A. System Smoke Detectors

1. General
  - a. Comply with UL 268; operating at 24-V dc, nominal.
  - b. Detectors shall be four (4) -wire type.
  - c. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

- d. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  - e. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  - f. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
  - g. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.
  - h. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.
  - i. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    - 1) Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    - 2) Photoelectric detectors shall be factory calibrated and shall be settable at fire-alarm control unit to operate at 3.0 plus or minus 0.25 percent obscuration per foot.
2. Photoelectric Smoke Detectors:
- a. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  - b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - 1) Primary status.
    - 2) Device type.
    - 3) Present average value.
    - 4) Present sensitivity selected.
    - 5) Sensor range (normal, dirty, etc.).

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 and the VA FPDM as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with Section 16111 "CONDUIT SYSTEMS," Section 16127 "CABLES, LOW VOLTAGE," and all penetrations of smoke and fire barriers shall be protected as required by Section 07270 "FIRESTOPPING SYSTEMS."
- B. All new conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. All existing accessible fire alarm conduit not reused shall be abandoned in place and labeled "SPARE".
- C. All fire detection and alarm system devices shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Audible Alarm-Indicating Devices: Install ceiling mounted devices as shown on plan drawings, and adhering to the requirements of the applicable codes and standards referenced in this specification.
- E. Visible Alarm-Indicating Devices: Install ceiling mounted devices as shown on plan drawings, and adhering to the requirements of the applicable codes and standards referenced in this specification.
- F. Speakers shall be ceiling mounted and fully recessed in areas with suspended ceilings. Speakers shall be wall mounted and recessed in finished areas without suspended ceilings. Speakers may be surface mounted in unfinished areas.
- G. Ceiling mounted strobes shall extend below the finished ceiling in which it is installed, and shall be visible in all directions with no obstructions adjacent to it. Locate and mount to maintain a minimum 36 inches clearance from side obstructions.
- H. Smoke- or Heat-Detector Spacing:
  - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
  - 2. Smooth ceiling spacing shall not exceed 30 feet.
  - 3. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
  - 4. HVAC: Locate detectors not closer than 5 feet from air-supply diffuser or return-air opening.
  - 5. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

- I. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

### 3.2 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section Requirements for Electrical Installations.
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.3 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

### 3.4 TESTS

- A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COR.
- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meet all contract requirements. After the system has passed the initial test and been approved by the COR, the contractor may request a final inspection.

- 1. Visual Inspection: Conduct visual inspection prior to testing.

- a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
- b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
4. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
5. Open each new alarm initiating and notification circuit to see if trouble signal actuates.
6. Test new audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
7. Test new audible appliances for the private operating mode according to manufacturer's written instructions.
8. Test new visible appliances for the public operating mode according to manufacturer's written instructions.
9. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

### 3.5 FINAL INSPECTION AND ACCEPTANCE

- A. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.5 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

- - END OF SECTION - -